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THE

# JOURNAL OF SCIENCE.

JUNE, 1884.

## I. WHAT IS RELIGION? HYLO-IDEALISM?

By S. BILLING.

A PAMPHLET with the above title, by C. N., annotated by Dr. Lewins, with Appendices, is intended more or less to exemplify Hylo-Idealism, which he assumes should take the place of all other religious philosophies. Several notices on the subject appeared in the "Journal of Science," difficult to understand because, unconnected, they conveyed the impression (to my mind) of an ill-digested Materialistic propaganda. By advertisement it appears the subject is collected and presented as a whole, by C. N. and Capt. McTaggart, aided by a critique of the latter work in the March number of this Journal. The critique by your reviewer excited my attention, and induced me to read the pamphlet. The reviewer, with his usual kindness, has conveyed a favourable impression of the work; but it appears to me he has either been biassed in his judgment, in his desire to say pleasant things, or he is wanting in that logical discernment so necessary to be employed on subjects of this class. I fail to find in this review that comprehensive grasp and powerful acumen which are so ably exhibited when the examination of works on Biology, Chemistry, and other subjects of *pure* Science are the questions in comment.

The time was when some learning was required to write even a comment upon received opinion, but this is all reversed; flippant observations now have the place once occupied by research and learned lucubrations, bald assumptions are paraded as results, and great names spice the

production. Imagination in lieu of learning becomes the basis of the arguments, and such authors (as did George Sands, but without her powers) proclaim the necessity of a New Messiah, wherein moral obligation and duty based on religious sentiments are to be erased from the mind. Comte tried this system, when his philosophy was found inadequate to satisfy humanitarian needs; even his followers confess the mess he made of it. This positive science is frequently quoted, and has found able defenders, but none of them advocate the "*Nouveau Grand-Etre Suprême.*" "A gigantic fetish, turned out bran-new by M. Comte's own hands, reigned" instead of the displaced Dieu. Who, in the now day are they who come forward to explain the mystery and gaze unblinking into the depths of the light, and measure the immeasurable vastness to a hair?" "They step down to the people with stately step and voice of authority, and deliver their twopenny tablets as if there was some Divine authority for the wretched nonsense recorded there." What does all this philosophical "friskiness" lead to? Their professors are so wonderfully sagacious that they flounder at every step; so clear-sighted that they cannot see existing things; their "extinguishing" genius would "put out every light sufficient for the conduct of common men." Oh! men of genius never take heed of duty; it is the manacles of slaves, and when you have grown sick of your liberty assert license, and scoff at the morals and religions of men who possess them. What are their feelings and opinions? Take refuge in your philosophy; never mind whether it has consonance, intelligibility, or logic; stick to it as Diogenes did to his tub; if it answers no other purpose it will at least show that you have a pride in your opinions. Take no heed how often they have been refuted, or how stale the propositions; never heed that they are nonsense, so that some scheme is preached which shall end in annihilation or in a rehabilitation in some material phenomenon.

The key-note of the new philosophy is "that man is the measure of the universe." We are further told "that man sees himself mirrored in Nature,"—what may this mean?—and "no man has defined the ultimate limits of Nature." Perhaps there are some far depths only discoverable by the Hylo-Idealists: its Messiah steps in to aid with a note, "Man knows and feels that Nature is mirrored in himself, being the image of his Ego, and not *vice versâ*." The Ego may be the result of natural facts, but then certainly not isolated. Where in Nature—that is, in phenomena—are we to discover

this intellectual image? It is apprehended that we must go beneath phenomena to find this intelligence.

Perhaps a word of advice from the learned, gentle, and devout philosopher Schleiermacher may be opportune. He says—"Beware of the writings of authors who reveal the petty, selfish, intolerant spirit . . . in their endeavours to spread their own fame and force their systems on others under the pretence of enlightenment." "The truly wise, the further they penetrate in their investigations of truth, the more modest they become and the more distrustful of themselves,—ever alive to inward deceit and prejudice, which blinds the understanding, regardless of that noble freedom of thought which submits to no law but that of truth."—("Life," vol. i., p. 76.)

No man has a greater respect for ratiocination and freedom of opinion than I have, but at the same time I do not think that undigested comments should be obtruded in such a manner as to be an insult to the opinions of others. The most harsh and disagreeable conclusions can be forcibly presented without that obtrusive impertinence so generally adopted by would-be philosophers. We have a specimen of this mode in the pamphlet in question, together with its very stale appendices. C. A.'s letter in the April number of this Journal is also an apt specimen of the style adopted. She were better employed in woman's vocation—as Iago suggests, "suckle fools, &c."—than so to write. C. A., however flimsy the mask, has torn it from the Hylo-Idealism theorems, and says that the protoplastic substance paraded as a cause is pure Monism. The religious feeling, and happy are they who have it, however illogical may be their conclusions, their opinions are at least entitled to respect, and should not be subjected to the ribald rubbish with which C. A.'s letter concludes. An argument advanced or a discussion is quite permissible, but it should be an argument, not a sneer. It is more than probable the Athanasian Creed is more capable of defence than this Hylo-Idealism; an analogous proposition can be found in the triune idea—Matter, Life, and Intelligence—as constituting unity, the Ego; each incomprehensible, for no finite apprehension has hitherto solved their origin. So equally incomprehensible is the philosophical theses, to be and not to be,—*i.e.*, being and not being, at one and the same instant. We could go through philosophies and find propositions equally extravagant. If C. A. were endowed with the wonderful lore that she and her fellows ascribe to themselves, it is surprising that she advances arguments so feeble, and at the same

time conceived in such bad taste. Whatever be the teaching of the Athanasian Creed it is much better than that she advances, the fundamental principle of which is the self. A few individuals probably would reserve to themselves propriety of conduct, but as the common creed of man it would be subversive of all morals and order, and would loose the most degrading despotism, and make the most disgusting license the rule and practice.

Prof. Huxley tells us that Science is "trained common sense,—*i.e.*, the experiences of man verified by observation. If this axiom is applied to Hylo-Idealism, where are we? All intellectual aspirations and moral obligation ignored, nothing left but the individual self,—"thinks,"—the inspirations of phenomenal images,—we can then, having our origin in matter, but think matter. "It was the dogma of the Sophist that man is the measure of all things; it should not be the dogma of the sober thinker" (H. G. Lewes). What says the great Idealist, Berkeley, who teaches there is only one substance, *viz.*, Spirit, and with this he can "construct the world." "Of the existence of matter we have no proof whatever; it is a mere inference: it is inferred in order to explain phenomena, and what phenomena? Those of perception—*i.e.*, the phenomena of the thinking substance." Hume said Berkeley's hypothesis admitted of no answer, but produced no conviction. H. G. Lewes says—"and we have met with no final refutation of it." "That the theory is opposed to the irresistible belief of man is no refutation of it, because it does not follow that irresistible belief is true,—*e.g.*, for many ages it was believed that the sun revolved around the earth; the belief was irresistible, and false." So now that the sun rises and sets, when the sun is said to set the earth revolves from west to east, and so obscures the sun; also when it is said to rise it is the revolution of the earth which makes it apparent. It is a continuation of the old belief, and has correction in Science. Kant said "Admitting Idealism to be as dangerous as it really is, it would still remain a shame to philosophy and reason to be forced to ground the existence of an external world on the (mere) existence of a belief."—(*Vide* "Biog. Hist. Phil.," p. 274, *et inf.*) In all matters of belief the true question is, Is the belief well founded? If Lewes, Hume, Kant, and a host of reasoners are in opposition, What is the answer of the Hylo-Idealists? That man is the measure of all things; that thinks are things; that there is but the Ego—hence that all knowledge is individual. Further on we shall see C. N.'s exposition. The great error

in all these discussions arises, as it appears to me, is the maintaining that there are *states* of consciousness. *We are conscious or we are not conscious.* Consciousness is indivisible: there are states of mind, of thought, of intelligence, of sensation; and unless mind, thought, intelligence, and sensation—which are each individual and distinct—mean consciousness, there can be no states of consciousness. Consciousness defines and represents the action of a something which it makes apparent as an effect or a cause, as the case may be. Man is made up of inorganic compounds energised by vital power, intelligence, sensation, and animal instincts, by the combination of which he has the consciousness of external phenomena; he cognizes not only his own thought, the self, but the non-self also,—*i.e.*, the Ego and the non-Ego: this is the practical illustration arising from the fusion of intelligence, sensation, and animal instincts, whatever metaphysical idealism and materialistic assumptions may assert to the contrary. The external world is as much a part of man as his own Egoism, and this makes human life and human aspirations possible on the humanitarian principle of communion with his fellows, whereby a common characteristic intrudes into phenomenal observance, and makes man one in the unity of consciousness. Nature is the general bond and the general instructor. The consciousness grasps phenomena, and man's intelligence informs him of their meaning and use. In the analyses of phenomena man gets behind and within, and the enquiry is then as to causes. This is no question of "thinks" (imaginations), but a question of things conducted by a process of analytical dissection, observation, and experiment, ending in an intellectual synthesis which informs the mind: this is the only process by which Science is made possible. By this method of investigation, however, the solid phenomena vanish, we are landed in gases, and a something even beyond them: by this system we arrive at gases in layers only held in their places by the gravitation of their particles, the true equivalent of which is weight; and thus, by reason of their inertia, they would ever remain but for an external something of which even the Materialist admits the necessity. All the grand processions of phenomena vanish, and there remains, so far as perception is concerned, an indistinguishable mass, without form, without impulse, without sensation. Perforce then we fall back on the origin of formation,—*i.e.*, intelligence, or its grander and truer name, the first cause. To argue that intellect is the result of gases in strata (leaving out altogether the hypothesis of the fire

miest, for that, if it ever occurred, was a something in advance), thereby utterly forsaking the grand panacea common sense, which itself is a product of intellect emancipated from the thralls of philosophies through observation and experiment; it is much more reasonable to suppose that matter had its origin, or at the least derived its formative power, from intellect, than that intellect had its origin in matter. When we talk of material phenomena we in reality talk of intellectual manipulation,—*i.e.*, intellect embodied in the phenomenal display. If arrangement in the arts is due to intelligence, by a parity of reasoning we are compelled to admit that natural phenomena is the product of intellect, and of an intellect so powerful in its grasp that it compels homogeneity and unity,—for we must remember the scientific axiom that "the unknown is to be interpreted by the known." Is it now possible to say that intellect originated from matter, which at its best is but a plastic substance dominated by intellect which wills and executes? Matter does neither; inert until vivified by intelligence. When the Materialist bases his creed upon matter he ignores himself, forgetting that force is an impulsion not born of itself, but becomes active by an antecedent impulse. An effect embodied in its antecedent effect becomes a cause; so an effect becomes the cause of a succeeding effect, rolling in a grand sequence resulting in orderly arrangement; this is progression in its real meaning,—the evolution of effects bound up in their antecedent causes; the universe of effects resulting from the primal cause, mayhap Aristotle's unmoving centre.

All this appears to me the commonest of surface reasoning; cause and effect as impulsed by intelligence, and so maintained in homogeneity. Go back as we may, it is but to find a ruler and a maintainer. We may talk of matter and force, but after all we are never rid of "the pusher and the puller"—vital intelligence. Call it what we may—"protoplastic" if you please—that which embodies, fashions, and maintains is the Creator, and in psychological existence we find a grander name, a more potent existence, unfolding the cause of the origin of all phenomena. When the Materialist talks of Nature, does he set bounds to Nature? does he know the all of Nature? Who shall prescribe its limits? The material and the psychological are unity as we know it —within, surrounding and without material phenomena. There is an occult something existing in the very womb of Nature—we know and feel it to be there, although we cannot penetrate to it—which no finite ideas can grasp, and its

realisation in human intelligence is by abstract reasonings. If we summon the beliefs of man as an evidence, the evidence is most conclusive, for never has there been a people found who have not this abstraction,—presented as creeds, cults, superstitions, worship of dead ancestors, &c., all pointing to the belief of a life beyond the earth life. If, then, there be a life beyond the grave—and of this I have no doubt, Science leads to such a conclusion—it is clear there must be a link with the unknown, and there is to be found the Interpreter and the Law-giver. Is it because man has discovered the method of some of the mechanics and chemistry by which Nature produces her results, that therefore he comprehends the all of Nature, its origin, and end bounding the Universe, by his own narrow perceptions? The very fact of his limitation and cognition shows that intelligence is a working principle, for without intelligent consciousness where were all his theories? Himself in his "*thinks*" omnipotent and a God—pshaw! Carry back his histological learning a few centuries, what did he know of the kingdoms of the Infusoria, which play so great a part in the economy of Nature? "Life swarms everywhere, life preys on life; whence is this inexhaustible flood of existence, from the atom fluttering in the sunbeam up to the star lost in the depths of infinity? what principle can we discover to explain this limitless, eternal, and boundless prodigality?" A principle of being there must be. What did we know of the order of the systems of worlds and luminaries, of suns in strata, in myriads. If these grand additions to scientific knowledge are the results of few centuries, what may we not hope for with the improved scientific appliances and methods of culture in the coming eras of existence? We may know even the unknown, and discern what we now conceive to be an unembodied reality. To limit thought, mind, soul, and the all of the great unknown to an origination from matter is ignoring the very being of man. Step by step, from the protamœba to the human, man has ascended organically and intellectually, until he has become a thinking, intellectual, conscientious, and moral being. To what end? To perish utterly? To become dust, to pursue the same round commencing again where he began? It is an illogical sequence. If progress and development and evolution mean anything, it (if they are one) means the attainment of a higher phase than that of perception, or even of human conception; the intellect must expand and obey the law until the illimitable is reached,—possibly a resolvement into its origin, as Buddha taught. It is in the unknown we can know the why and the

wherefore. We cannot resolve the Infinite: the ancients were wiser than we; they accepted benefits, and thanked the Gods. The inscription on the Temple of Isis was a check to man's presumption:—"I am what I am: none have ever penetrated the mystery which surrounds me; none ever will penetrate it."

And with Thackeray say "I would rather live in a wilderness of monkeys, and listen to their chatter, than in a company of men who deny everything."

If C. N. wishes to stand forth to the world as the expounder of a new philosophy, a drastic reforming of the world's ideas, as he assumes, why does he not give his name in full? Surely he is not so modest as to "hide his light under a bushel"?—a small tin pot would be a nearer ideal. It is too much the custom of those gentlemen who pretend to know more than their fellows; and when they, as they suppose, lead an onslaught into those regions which thinking men deem sacred, shelter themselves under an initial or a *nom de guerre*,—as Saladin, Julian, &c.,—who send forth pæans *in excelso*, and join in a chorus of adulation each of the others' extreme ability, and in imagination join in the shout—Behold the lights of the intellectual world. And what is the upshot of these rhapsodies? a recapitulation of very stale metaphysics, old philosophies, and rank Materialism: their inspiration appears to be Dr. Buchner, and the low school of German thought; Dr. Lewins, the Messiah of the movement, adopts the old sophist Protagoras. From this category it is fair to except Captain McTaggart, who has really presented a very masterly attempt to defend a really indefensible position; he has said much in correction of the uttered absurdities, and yet ends in a most illogical manner, *viz.*, in the acceptance of this very crude assumption, Hylo-Idealism, of which neither of its parts, Materialism and Idealism, are pursued to their logical conclusions. McTaggart, McTaggart, you are capable of something better than this. Prof. St. George Mivart's work, "Nature and Thought," in its first three divisions,—"The Inner World," "The Outer World," "The Intellectual World,"—has anticipated all the Hylo-Idealistic theories, and has refuted them. All the arguments adduced in support of the theory in that work meet their answer. It is a work I should recommend for the perusal of Dr. Lewins and his enthusiastic proselytes. If Capt. McTaggart has not met with the work, he will find in it a congenial study; if he has met with it, then I am utterly at a loss to account for the conclusions he has arrived at. Its last division "Causes and

Consequences," leads to an advanced thought: it is too hopeful an idea to suppose that these large talkers could grasp it.

I have thought it well to parade the opinions of the Sophists on which this doctrine of Egos, non-Egos, and "thinks" are founded, and set forth some opinions of Berkeley, the great Idealist, and his commentators. Unfortunately, although the Hylo-Idealists claim Idealism it is not the Idealism of Berkeley, who centres the whole of his assumptions in the consciousness of God.

As to Protogoras, who is assumed to be the base of the pillar, what was his teaching? Protagoras of Abdera (480 B.C.) His saying "that man is the measure of the Universe" contains the marrow of the philosophy of the Sophists,—*i.e.*, "that our *individual* judgments and feelings were the standards of the true and the false, of the right and the wrong; that whatever each man regarded as right was right, and that whatever he regarded as true was true," which doctrine, Dr. Ferrier rightly says, "obviously unsettles the foundations both of truth and of morality, and opens a wide door to every form of ignorance and licentiousness." The ultimate assumption of the Sophists was "that sensation is the essential attribute of man." This assumption was grappled with and overthrown by Socrates and Plato, who showed that thought (something essentially different from sensation) is the fundamental attribute of man, by showing that ideas were the common property of all intelligence, whilst sensation is limited and particular, and thus they asserted that man is competent to the attainment of that which is absolutely and universally true; they admitted that man is "the measure of the Universe" in so far as he is a thinking, but not in so far as he is a sensational, being.

G. H. Lewes ("Biographical History of Philosophy") says, let us suppose that Protagoras accepted the doctrine of Democritus excepting "*the atomic and reflective:* these two imply each other; reflection is necessary for the idea of atoms; and it is from the idea of atoms, not perceived by the sense, that the existence of reflection is proved." "He said thought was sensation, and all knowledge consequently individual." Lewes seems to suppose that Protagoras derived his doctrine from Heraclitus, who maintained "the doctrine of thought being identical with and limited by sensation. Now this doctrine implies that everything is true *relatively*,—every sensation is a true sensation, and, as there is nothing but sensation, knowledge is evidently

fleeting and imperfect." In such a mind as that of Heraclitus "such a doctrine would deepen sadness, till it produced despair." With Protagoras the formula was "Man is the measure of all things."

Sextus Empiricus.—"Matter, says Protagoras, is in a perpetual flux whilst it undergoes augmentations and losses; the senses also are modified according to the age and disposition of the body; that the reasons of all phenomena (appearances) resided in matter as *substrata*, so that matter, in itself, might be whatever it appeared to teach. . . . . Whoever is in a healthy state perceives things such as they appear to all others in a healthy state, and *vice versâ*. A similar course holds to different ages, as well as in sleeping and awaking. Man is therefore the criterion of that which exists; all that is perceived by him exists; that which is perceived by no man does not exist."

"The Sceptics were content with the conviction of the insufficiency of knowledge; the Sophists had the vanity and desire to penetrate the mysteries of the Universe. In their visits to various cities they found varieties of laws and ordinances, and this convinced them that there were no such things as right and wrong by nature, but only by convention. This because of their corollary of their dogma respecting truth. For man there was no eternal right, because there was no eternal truth. This denial of abstract truth and abstract justice is easily pushed to absurd and immoral consequences."

The Sophists were the natural production of the opinions of the epoch, and in them is seen the first energetic protest against the possibility of metaphysical science. It was the protest of baffled minds. The scepticism of the Sophists was a scepticism with which no great speculative intellect could be contented (*vide* pp. 98 to 103 inclusive).

Tennemann's notice of Protagoras is as follows:—"He maintained that human knowledge consists only in the perception of the appearance through the subject, and that whatever appeared to any one in his state at the time was true; consequently that man is the standard of all things; that, as far as truth or falsehood are concerned, there is no difference between our perceptions of external objects; that every way of considering a thing has its opposite, and that there is as much truth on one side as on the other; and that, consequently, nothing can be supported in argument with certainty; maintaining at the same time the sophistical profession to make the worse the better argument."

He doubted the existence of the Gods.* Yet he must have believed in the Gods, or why would he be content to take such remuneration for his teaching as his pupil was willing to pay, only requiring him to go into a temple and make oath that it was his sincere belief that the sum was sufficient (*vide* Grote's "History of Greece," vol. vii., p. 45).

Grote, speaking of this philosopher, says—"He taught that man is the measure of all things, both of that which exists and of that which does not exist—a doctrine canvassed and controverted by Plato, who represents that Protagoras assumed knowledge to consist in sensation, and considered the sensations of each individual man to be, to him, the canon and measure of truth."

The only author I have met with who seems inclined to defend Protagoras is Grote, but he was the general defender of the Sophists. He says—"In so far as we can understand the theory, it certainly was no more incorrect than several others then afloat from the Eleatic school and other philosophers, whilst it had the merit of bringing into forcible relief the essentially relative nature of cognition,—relative not indeed to the sensitive faculty, but to that reinforced and guided by the other faculties of man, memorial and ratiocinative; and had it been more incorrect than it really is, there would be no warrant for those imputations which modern authors build upon it against the morality of Protagoras. No such imputations are countenanced in the discussion which Plato devotes to the doctrine: indeed if the vindication he sets forth against himself, on behalf of Protagoras, be really ascribable to that Sophist, it would give an exaggerated importance to the distinction between good and evil, into which the distinction between truth and falsehood is considered by the Platonic Protagoras as resolvable. The subsequent theories of Plato and Aristotle respecting cognition were much more systematic and elaborate, the work of men greatly superior in speculative genius to Protagoras; but they would not have been what they were had not Protagoras, as well as others, gone before them with suggestions more partial and imperfect."—(*Id.*, vol. vii., pp. 50, 51). Aristotle, discussing the doctrine of Protagoras, says "that this doctrine comes to no more than saying that man, so far as he is cognizant or so far as precipient, is the measure of all things; in other words, that knowledge or

* "Respecting the Gods I neither know whether they exist nor what are their attributes; the uncertainty of the subject, the shortness of human life, and many other causes debar me from this knowledge."—GROTE'S *History of Greece*, vol. vii., p. 48.

perception is the measure of all things. This, he says, is trivial and of no value, though it sounds like something of importance."—(*In notis, Ibid.*)

Gorgias, a contemporary of Protagoras, wrote a treatise on Nature, or that which is not. He says, "Firstly, that nothing exists; secondly, if anything exists it cannot be known; and thirdly, if anything exists and can be known the knowledge cannot be imparted." Tennemann's exposition of Gorgias is, first, that nothing real exists, because neither negative nor positive; nor both at the same time can really exist; but even granting that something real did exist, yet, *second*, it would not be cognisable, because if thoughts are not real things the real cannot be thought; and if thoughts were real things that which is not real could not be thought; consequently everything thought must be real in that case. Finally, even if something were cognisable, it could not be imparted by the medium of words, because words do not express things, and nobody thinks like his neighbour." Grote says the teaching was "that nothing exists; that if anything exists it is unknowable; and granting it even to exist, and to be knowable by any one man, he could never communicate it to others." Grote observes that the modern historians of Philosophy denounce the scepticism of the Sophist, "instead of explaining his thesis in immediate sequence with the speculations which preceded it." "In our sense of the words it is a monstrous paradox." "The word existence as they understood it (the Eleatic philosophers), did not mean phenomenal, but ultra-phenomenal, existence. They looked upon the phenomena of sense as alway coming and going,—as something essentially transitory, fluctuating, incapable of being surely known, and furnishing at best only grounds for conjecture. They searched by cogitation for what they presumed to be, the really existing something or substance—the noumenon, to use a Kantian phrase—lying behind or under the phenomena, which noumenon they recognised as the only appropriate objects of knowledge; they discussed much whether it was one or many." This probably is the protoplastic substance of the Hylo-Idealists. "The thesis of Gorgias related to this ultra-phenomenal existence, and bore closely upon the arguments of Zeno and Melissus." "Protagoras and Gorgias found predecessors indeed, but no binding precedents to copy, so that each struck out more or less a road of their own." "We do not know how far Gorgias agreed in the opinion of Protagoras, that man is the measure of all things."—(Grote, *Ibid.*)

G. H. Lewes says—"The Sophistical art may have been essentially corrupting, although to contemporaries it did not appear so. We believe it was so, if it is to be made responsible for all the consequences which can be logically deduced from it. But logical consequences are unjust standards. Men are not responsible for what others may consider their doctrines lead to."

G. H. Lewes's opinions appear to have excited the reverence of the Hylo-Idealists: a philosophy they term it. His concluding remarks in his "Biographical History of Philosophy" suggest the impossibility of philosophy: he says, "If any one remains unconvinced by the accumulated proofs this history affords of the impossibility of philosophy, let him distinctly bear in mind that the first problem he has to solve is—Have we ideas independent of experience?" (I unhesitatingly answer, Yes. Our ideas of God are not the results of experience. We adduce them from the homogeneity of Nature, based on the scientific axiom that the known must interpret the unknown.) "Look at the state of philosophy: there is no one system universally accepted; there are as many philosophies as there are speculative notions,—almost as many as there are professors." The opposition between Religion and Philosophy is "inevitable; it lies in the very nature of philosophy; and although now, as heretofore, many professors eagerly argue that the two are perfectly compatible and accordant, the discordance is, and always must be, apparent." The evil of the speciality of scientific men, or their incapacity, is not confined to the neglecting the whole for the sake of the parts; it affects the very highest conditions of Science, namely, its capacity of instructing and directing society. So we have general ideas and positive science: the general ideas are powerless, because they are not positive; the positive sciences are powerless, because they are not general." Lewes says, so far as regards philosophy, we in the nineteenth century are precisely in the same position as we were in the fifth,

Speaking of Idealism, on the discussion of Berkeley's Idealism, Lewes says, "In admitting all this, what do we admit? Simply that human knowledge is *not* the measure of all things. Objects *to us* can never be more than ideas; but are *we* the final measure of all existence? It was the dogma of the Sophist that man is the measure of all things; it should not be the dogma of the sober thinker. Because we can only know objects as ideas, is it a proper conclusion that objects only exist as ideas? For this conclusion to be rigorous we must have some proof of our knowledge being

the absolute standard of truth instead of the standard of the relation things bear to our intellect." He says he admits, with the Idealist, that all our knowledge of objects consists in ideas." . . . But not "that all existence is limited by our knowledge merely on the ground that where we could conceive anything existing we are forced to conceive it in accordance with the laws of our conceptive faculties." So also "that all our knowledge is subjective," but not "what is true subjectively is true objectively." So also "in the existence of an external world quite independent of any precipient,—not because such is the obvious and universal belief, but because the arguments by which Idealism would controvert it are vitiated by the assumption of knowledge being the criterion of all existences,—Idealism agrees with Realism in placing reliance on the evidence of sense; it argues, however, that inasmuch as our knowledge is confined to ideas, we have no right to assume anything beyond ideas. Yet it is also forced to assume something as the cause of ideas; this cause it calls the will of the Creator." This Lewes says is an assumption. It may be so; yet all systems have some principle, however they may disguise it. Even in the materialistic theory Lucretius was forced, by the necessity of reason, to adopt volition, "seeing that atoms left to their own action could never cohere, and would remain for ever inert." So he said of the Earth, "she being impregnated produces." This fecundating principle he terms the ether. So, whether it be Materialists or Hylo-Idealists, there is always a something intervening other than the fundamental principle of the system. Idealism logically ends in spirit; Materialism in gross substance. Lewes says that Spinoza taught that there was but one essence in the universe, and that one was substance. Berkeley also taught that there was but one, and that one was thought. Now call this one what you will, the result is the same, speculatively or practically. You may have certain degrading associations attached to the idea of substance, or certain exalted associations attached to that of spirit. But what difference can your associations make with respect to the real nature of things."

Above is presented all that can be said of the philosophies, *viz.*, those of Protagoras and Gorgias, on which is founded the system in discussion, together with G. H. Lewes's remarks, showing his ideas generally on the subject.

**(To be continued.)**

## II. ON ELECTRICITY AND ITS PRESENT APPLICATIONS.*

By W. Fraser, A.M., M.R.C.S. Eng.

IT is right to mention that this paper—or rather the nucleus of it—has been already read to a Medical Society and to an Ecclesiastical Guild, a statement you will readily believe from some passages in it—*entrées*, I may say, in the entertainment—specially provided for the tastes of these guests. But now that I have ventured, though with fear and misgiving, to bring it before an audience of philosophers, who are quite competent to deal with the subject, I have added a few *pieces de resistance*, which may help to secure your attention, and afford something to eat up and masticate, whether you think fit to swallow and assimilate them or not.

An apology may be expected for my bringing before a Medical Society a subject not strictly medical, and I quite admit the validity of the objection. But although electricity has never been so far professionally recognised as to have a place in the Pharmacopœia, we all know that it has long been employed both as a diagnostic and therapeutic agent, and that of late it has proved a valuable method of treatment (particularly in nervous diseases) in the hands of several eminent London physicians.

We know, too, that in the present period of popular excitement it is beginning to take a prominent place in the field of quackery, with plausible and high-sounding pretensions, and in such a way as will probably prove an obstacle to its employment in legitimate medicine. I do not think, however, that legitimate medicine will suffer much by the loss, for whatsoever may be the influence that Electricity has in regard to the functions of the human body,—and it is undoubtedly great,—this influence or these influences can best be brought into action through the judicious use of the old and ordinary means, whether pharmaceutic or psychologic,—acting as these do, through the nervous or electric functions of the body itself,—which the profession has long been accustomed to employ.

* Read at the Aberdeen Philosophical Society, February 5th, 1884.

I do not, therefore, intend to treat the subject specially in its medical aspect, and shall, without further apology, bring it before you in the way that has happened to approve itself to me. You will not, I hope, take offence if I ask you, during the reading of the paper, to fancy yourselves in the position of a group of children, or of untutored natives of the East listening to one of their own story tellers, while he tries to please them for an hour, and to convey to them some practical and useful instruction by the scenes and sketches he places before their imagination.

When the Allwise, Omnipotent, and Eternal created and organised this world, he placed in it certain Genii, immortal but soulless spirits,—His slaves or ministers, as they might be called,—to carry out His will in its government, and in the purposes He had in view in its creation. One of the most powerful of these—the Genie of the mystic fire, Electron—is invisible to the human eye, and unrecognisable by the ordinary human senses, except upon rare occasions, or when subjected to the spell of a skilled magician.

It is difficult to give a correct portraiture and dimensions of this great spirit; but it may be said that, while his head reaches far above the clouds, and his feet go down into the bowels of the earth, and traverse them more freely than a bird can fly through the air, he can also enter into the smallest and invisible cell that forms part of the material of the globe. In truth he performs an important part in almost all the operations going on in the world, whether great or small; but so quietly and gently does he work that his presence is never known or suspected, except on the occurrence of something calculated to rouse him to anger or opposition.

The power and immensity of this Genie may be in some degree comprehended when it is stated that the tremendous roar of his voice, the dazzling brightness of the flash of his eye, the inconceivable rapidity of his movements, and the irresistible force of his strength are such that in respect to them there is no terrestrial being that can be compared with him. When careering with his full force, if any obstacle should interrupt his progress or tend to circumscribe his liberty, he will in a moment burst the strongest barriers in his way, shattering and destroying them by streams of fire which he launches forth, accompanied with such appalling and tremendous bellowings as seem to make the earth to tremble. Such behaviour on his part naturally inspires mankind with terror and awe, and it has had the effect, in past times, of deterring them from cultivating his

acquaintance or friendship. Indeed, until very recent times, they looked upon him more in the light of God's minister of punishment and destruction than as the friendly and beneficent, though powerful, being they are now beginning to discover him to be.

A wise man of America, named Benjamin, who, more than a hundred years ago, was among the first who had the courage, sagacity, and tact to enter into close and friendly relations with him, by a careful study of his character and habits, succeeded in making an arrangement by which—in consideration of an easy and free passage being provided for him between his favourite resting-place under the ground, and the upper air—he gave promise for the future to refrain from an old and destructive practice he had been in the habit of indulging in,—that of toppling over and destroying towers, chimneys, and other lofty buildings that chanced to attract his notice. And the fact of his having honourably kept this promise has led to a further study of his powers and peculiarities, and to the cultivation of more friendly relations with him than had been done before.

He is constantly hovering and brooding over the earth, mantling and pillowing himself in the clouds; sometimes marshalling them in hostile array against each other, travelling with them in their movements, and descending with them in union with the rain, to refresh and fructify the ground; ascending, also, as well as descending, by secret and imperceptible movements, in the fulfilment of the innumerable services which God has ordained him to perform. Though such is the usual and gentle manner of his transition between earth and sky, yet it sometimes happens, when he finds himself unduly confined on the one side, that he will make a sudden and irresistible bound to the other, overturning, blasting, and destroying whatever may stand in his way, and emitting a roar of thunder surpassing in awe-inspiring grandeur the cries of all the wild beasts of the forest blended together.

By following in the wake of the American *savant* electricians have succeeded in greatly mitigating—in many cases in entirely averting—the calamitous effects of such occurrences. Knowing the partiality he has for certain of the family of the metals, and the willingness with which he will accept of their guidance and means of transport, they have constructed roads (literally rods) of iron, copper, or bronze between the earth and the highest points of the chimneys and lofty buildings that were wont to be injured by him. These rods or tubes are provided with incorrodible points—

often trifurcate—at their upper extremity, and the Genie gives a very decided preference to this kind of passage, both by way of exit and entrance, and when making use of it he is quietly led either downwards or upwards, whichever way he requires to go, till all danger of a sudden outburst is past.

For many ages mankind were almost unaware of the presence among them of this powerful spirit; nor did they know that he was unceasingly employed in their service; and much less were they able to summon him at will to appear visibly and tangibly before them, to exhibit some of his wonderful powers. When at last they did succeed in this the utmost wonder and interest were excited by the display, although the form it took was what might at present be looked upon as mere childish tricks compared with the stupendous and beneficent powers of which he is now proved to be possessed. His favourite resting-place of retirement is, as I have said, deep in the interior of the world, from which, however, he is continually emerging and gliding to and fro through the earth and the air, doing an infinite variety of useful and beneficent work; after accomplishing which he, by the law of his existence, quietly retires to the place of his concealment. But if anything should stand in his way, or resist his passage, woe be to that person or thing! Personal injury, or even destruction or death, is sure to be the result.

While thus pent up, miles deep in the interior of the earth, and finding no ready means of escape, he will sometimes break the bonds of his prison and force a passage or place of exit for himself, and in doing so shake the earth for miles around, leaving great rents in it, overturning buildings, destroying millions' worth of property and thousands of lives. This heavy charge, at all events, has been brought against Electron as one of the various hypotheses that have been suggested in explanation of earthquakes. But though he may in some degree be connected with these phenomena, there is far from sufficient proof that he is the principal or sole agent, and in a Court of Science the verdict could not be more than "Not proven." But *if he be* the great cause of these terrible convulsions, might it not be possible that the happy invention of Franklin, which has averted so many of the disastrous effects of aërial and surface lightning, could also, in some way, be applied to the deep underground storms (if indeed the depth were not too great) which are supposed to be connected with earthquakes?

Colonel Arthur Parnell, writing on the subject in the

"Journal of Science" for December, 1883, adduces some passages from the Apocalypse to show that the inspired writer of that book considered lightnings, thunders, and earthquakes as being results of one and the same agency, though perhaps not of much scientific value as bearing on the question: these passages are sufficiently interesting and apposite to be re-quoted:—

"I saw the seven angels which stood before God, and to them were given seven trumpets. And another angel came and stood at the altar, having a golden censer; and there was given unto him much incense, that he should offer it with the prayers of all Saints upon the golden altar which was before the throne. And the smoke of the incense, which came with the prayers of the Saints, ascended up before God out of the angel's hand. And the angel took the censer and filled it with fire of the altar, and cast it into the earth; and there were voices and thunderings and lightnings, and an earthquake" (Rev. viii., 2—5). Again, "The seventh angel sounded, . . . and the temple of God was opened in heaven, and there was seen in His temple the work of His testament; and there were lightnings and voices and thunderings, and an earthquake and great hail" (Rev. xi., 19). And again, "The seventh angel poured out his vial into the air; and there came a great voice out of the temple of heaven from the throne, saying, It is done. And there were voices and thunders and lightnings; and there was a great earthquake, such as was not since men were upon the earth, so mighty an earthquake and so great" (Rev. xvi., 17, 18).

Notwithstanding the amount of work he is known to perform, Electron is also fond of dancing, and his favourite place for enjoying this pastime is in the neighbourhood of and around the poles of the earth. There, in a bright frosty evening, mortals may often get glimpses of his holiday garments fluttering and corruscating in all the beautiful hues of the rainbow, mysteriously vanishing and reappearing as he disports in the fantastic evolutions of his mystic dance.

It is not to be understood, from the repeated references to the favourite resting-place of Electron as being in the earth, that the sea receives less of his regard than the dry land. On the contrary, there is every probability that the sea is even more abundantly and unvaryingly his place of abode than the land. Water is far more congenial to him than land, and in it he can stretch out and rest himself more complacently than on land. His passage between the clouds and the sea will of course give rise to the usual phenomena attending similar transitions on earth, but there is nothing

in the ocean's boundless expanse of water to intercept his movements or rouse him to anger and violence. I believe that he is abundantly diffused through its whole extent down to its utmost depths, and that he is the means of imparting life and vigour, and exuberant—almost superabundant—fertility, to the multifarious and innumerable creatures that have their habitation there. The very atmosphere of the sea is impregnated by him to a greater extent than that of the land. The superambient air is ozonised or charged with his influence, and thus rendered, as is well known, salubrious and life-giving to invalids, after the ordinary resources of medicine have failed.

In illustration of these statements it may be allowable to refer to the significant fact that while there are at least a dozen fishes that are provided with electrical organs, and capable of using them both for sustentation and defence, there are no land animals known to be so endowed. The fishes referred to "belong to three widely different groups,—namely, rays, eels, and sheath fishes,—which would seem to indicate that electric organs have originated independently in each group. The electric eel of South American rivers is the most powerful of these creatures, growing to a length of 6 feet, and provided with a pair of batteries containing hundreds of minute cells, copiously supplied with nerves, and capable of sending forth a shock which will paralyse the largest animals." *

While it is only within the last few years that man has been able to make use of electricity as a weapon of war against his enemies, these creatures have for many thousands of years—probably before man appeared upon earth—been applying their electrical batteries to the art of capturing their prey,—electric batteries, be it observed, which "behave in exactly the same manner as those constructed artificially, rendering the needle magnetic, decomposing chemical compounds, and emitting the spark."

For the capture and taming of wild and vicious animals, might we not be able to take a hint from these facts in Natural History?

Electron exerts a mysterious but powerful influence on the sensations of living—probably all living—creatures. The behaviour of many of the lower animals gives well-understood indications and warnings of changes of weather to be expected from his approach or his movements. In the human body, also, he can by his presence induce the most

* Longman's Magazine for March, p. 529.

pleasurable and salubrious feelings, or sensations of the most disagreeable nature.

There are various ways in which the Magi at first succeeded in conjuring this potent spirit, making him give indications of his presence. Sometimes this was done by making a grateful and rapid friction with a metallic or other substance of which he is known to be fond, through the medium or interposition of a suitable receptacle placed in communication or *en rapport* with the earth where he resides. The result is that he comes gradually into the vessel or trap, and indicates his presence by a crackling noise and the emission of sparks, just as is done by him when the back of a cat is treated in a similar manner. At other times he was tempted to make his appearance by a dish of metals stewed in an acid, for which he has a well-known predilection.

But now, by God's permission, the power has been given to the wise men of various countries—more especially those of Britain, France, Germany, Italy, Russia, and America—to secure, bind, and imprison him in a leaden vessel or casket, and to seal it with the seal of Solomon the Wise, so that he can be kept there as the submissive slave of his captor, carried to a distance, and when released forced to perform whatever work may be appointed him to do. In this way he can, under proper superintendence, be made to perform the work of a domestic slave or servant, in sewing, washing, &c., and even in lying on the watch and sounding an alarm in the event of robbery or of fire. He can also be made use of as the motive power of vehicles and machinery of all kinds. In short, he can be made to perform any kind of mechanical labour which does not require the direct exertion of mind and intelligence—gifts which God has bestowed on man alone. In view of the grandeur and immensity of his attributes we might almost think that the following sublime language of St. John, in the Apocalypse, is intended to pourtray him!

Rev. x., 1.—"And I saw another mighty angel come down from heaven, clothed with a cloud, and a rainbow was upon his head, and his face was as it were the sun, and his feet as pillars of fire; and he had in his hand a little book open: and he set his right foot upon the sea, and his left foot on the earth, and cried with a loud voice as when a lion roareth: and when he cried, seven thunders uttered their voices. . . . And the voice which I had heard from heaven spake unto me again, and said, Go and take the little book which is in the hand of the angel which standeth upon the sea and the earth. And I went unto the angel

and said unto him, Give me the little book; and he said unto me, Take it, and eat it up, and it shall make thy belly bitter, but it shall be in thy mouth sweet as honey. And he said unto me, Thou must prophecy again before many peoples and nations and tongues and kings."

The variety of designations that are given to Electron by scientists is apt to perplex those that are not familiar with the subject. These have been given according to the sources from which he can be educed, the forms he appears in, and the functions he performs,—such as positive and negative, static and free, Voltaic, Franklinic, and Faradaic, animal, frictional, and magnetic; and many besides. But these names, like the roll of names often given to potentates of the world, all belong only to the *one* great Genie who is the subject of our present discourse.

The motions which God has given to the great oblate globe of the Earth must, we should expect, cause relative motions on the part of such a mobile and ethereal substance (if substance it can be called) as that of this great Genie. We do not know the natural laws by which spirits are governed, but, speculating on their analogy to those which apply to the rarest of fluids and gases that we are acquainted with, we may to some extent be assisted to understand how such a spirit would comport itself in the world; though even the laws of acoustics or of hydro-dynamics cannot properly be considered as altogether applicable to so immaterial and imponderable a being as Electron.

The natural effect produced on these fluids by the rotation of the Earth would be centrifugal at the meridianal circumference and centripetal at the Poles. In the case of the Electric Spirit, supposing, as some with reason think, that it *has* the slightest amount of gravity, the rotary motion of the Earth would, at both ends of its axis, tend to draw it into the interior, which it would penetrate and traverse as easily as if it were a hollow sphere, and, the motion of the globe being greatest at its equatorial circumference, the spirit would find its way there; it would issue forth (refreshed and invigorated by his passage through the central fire of the Earth), imparting warmth and fertility to the tropical regions, though often giving indications of his superabundant presence, by frolicksome outbursts, which are sometimes attended by disastrous consequences. And thence he would become diffused through and over the atmosphere, and so would find his way back to the Poles, there to be again absorbed, and to enter on what might be called his normal circuit of the Earth. Thus the Earth

sustains the part of a vast storehouse, continually receiving detachments from this Spirit of the Universe by its great polar and other entrances, and as continually giving forth supplies by even more numberless exits.

Though one of the principal agents in carrying out the laws by which God governs the world, Electron is himself subject only to such laws as are adapted to his constitution and the purposes for which he was created; and the Supreme Governor has given permission to man, when he ascertains and pays deference to those laws, to make his own use, to a limited extent, of the powers and the service of this great spirit.

This powerful and ubiquitous Genie has close relations with all animate and inanimate things in the world. Between him and some of them there is a much greater attachment than with others, as, for instance, in the case of the metal iron, that greatest friend and servant of man of all the metallic race.

The further our researches and observations have yet been carried in this direction the more they tend to confirm the belief, inspired also by the study of other branches of natural science, that the Almighty wisdom and power operate by means at once the most uniform and simple in their individual and atomic manifestations, and unspeakably efficient, grand, and beautiful in their combined and predestinated outcome. The Universe itself consists of an infinite number of globes or spheres, in constant, regular, and multiplex motion, and having certain sympathetic influences and relations with each other through means of a property called gravitation. The ultimate or minutest division which we are capable of making of matter, as well as the most careful study of its properties, lead to the same conclusion as to its constitution, namely, that its atoms or ultimate components are also spheres either in motion or capable of being put in motion, and having opposite poles and attractive powers for other atoms, whether of the same or of different species. But instead of being called gravitation the attractive force of these atoms is known as chemical action, though it is believed by *savants* to be the effect of some special properties conferred upon them by Electron. And it is—beyond all his other qualities—by his power of imparting and governing molecular attractive forces that such all-important results are produced throughout the world as prove the Genie Electron to be the most powerful and omnipresent of God's ministers on earth.

When the particles of different kinds of matter are free to

mingle with each other—which by means of heat, air, water, and other media they can be made to do—he can make them change their arrangements, and can subject them to such magical transformations that they become entirely new substances, with appearance and qualities essentially different from their previous condition. That *he* is the immediate agent in effecting this may be fairly inferred from the analogous work he is known to do on a larger and visible scale, as well as on other reliable scientific grounds.

We can easily see the results and the accompaniments of this great spirit's working in many of the phenomena of the world, but no man has ever yet seen him *actually* at work or discovered his precise *modus operandi*. When God made himself known to Elijah it was not in the tempest, the earthquake, or the fire, but in the still small voice in the Desert. And so it is that the silent and secluded chamber of the scientist is also the most congenial and favoured place for contemplating the working of His great minister on the Earth. By long-continued transformations of the kind described he has changed, and is still changing, the aspect and condition of the surface of the world, and it is by a knowledge of these powers, and by the wisdom to take advantage of them, that most important results both to the initiated scientists, and, through them, to the world at large, are to be obtained. Out of three or four elementary substances, for instance, he can, under propitious circumstances, form a vast number of things, of very diverse qualities, adapted to enrich, sustain, and beautify the world and its inhabitants. Like a skilful general, or a clever master of ceremonies, he can place his subjects (small and invisible to us as they individually are) in all manner of composite groups, and in every variety of arrangement, and by his signal of command can make innumerable hosts of them embrace and coalesce, so as to constitute new masses, possessed of a character and qualities very different from those they had before, as well as from some other groups composed of the same elements. By operating through means of the different degrees of mutual affectian between these atoms and their chief, and for each other, he can bring about a sharp and rapid conflict amongst them, leading to their separation and rearrangement, so as to form new groups with characters and powers very different from those belonging to the previous groups, or to the individuals composing them. Individuals previously harmless or benign he will sometimes combine together, so as to form a band of poisonous murderers. Awkward and spiritless dolts he can

associate, match, and arrange together in such a way as to develop in them high-spirited and estimable qualities. By selecting, drilling, and arranging a lot of the most worthless and unattractive of things, he can turn out some of the most beautiful, useful, and valuable combinations that have in these times enriched the world. But besides the changes in regard to qualities easily recognised by our senses, such as colour, taste, and smell, there are many other and more subtle changes which he can effect that are not so readily appreciated by us.

The exact *rationale* of these changes is, I suspect, almost beyond our comprehension. With regard to colour, knowing as we do that Electron, if not identical with light, is allied and even superior to it, and may therefore be believed to have some command of those elementary colours contained in light, and it is quite conceivable that the molecules and the ultimate atoms of matter may have, through the influence of Electron, special affinities for certain of these coloured elements, or specially electrised atoms, if such they be, as we know that they have for the other spectroscopic elements of light, and that they will, in consequence, reflect some but absorb others, appearing in that colour which they reflect, and showing black if they absorb all, but white if they reflect them all.

So subtle and all-embracing is the essence of this great Genie that there is no part of the World, or of what it contains, that is not more or less imbued with it. But, though embracing all things, he shows a decided preference for some above others, and this in so manifest a way that the Magi who are devoted to his service have had no difficulty in making out a list of things in the order of his preference for them. Among those for which he shows the highest favour and attachment are the great family of the metals, and it is chiefly through their means that mankind have been enabled to become acquainted with his character and qualities, and with at least some of the laws by which he is governed in the work which God has ordained him to do. By their means it is, too, that his extraordinary powers are being more and more applied to the direct service and benefit of mankind. For example, while *we* can travel at the rate of a mile per minute along an iron railway, one of the same material, at a fraction of the cost, can be made to convey Electron with whatever store of intelligence we choose to entrust to him, thousands of miles, and to any part of the world, in the same space of time.

(To be continued.

## III. ON THE CHLOROPHYLL OF LIVING PLANT-CELLS, AND ON THE ASSIMILATION OF CARBON.

WE purpose laying before our readers the results of certain investigations which Dr. J. Reinke has communicated to the German Botanical Society, and which have appeared in its "Berichte" (Proceedings), as well as in the "Naturforscher" and in other foreign journals.

The reduction of the carbonic acid of the air is a function of light and of the chlorophyll of living plant-cells. If we wish to understand this process—the very foundation of vegetable nutrition—we shall find a study of chlorophyll in its solutions insufficient. We must instead, or in addition, examine the behaviour of chlorophyll with light, whilst it exists in the living vegetable cell. The remaining constituents of the living cell do not appreciably interfere, as in a purely green leaf they consist of colourless, transparent substances, which absorb light in a manner similar to chlorophyll, though less powerfully. In the case of transmitted light they are therefore inactive, and merely reduce the degree of illumination by reflecting and refracting a certain portion of the radiations.

The air which is present in leaves has doubtless a disturbing influence, on account of its low refractive power. Dr. Reinke expels it from the leaves by means of water, and thus obtains very satisfactory results.

He has determined the absorption-spectrum of the chlorophyll of the living cells in the leaves of numerous phanerogamous plants, by means of a micro-spectroscope. The various species show no differences of importance. All agree in proving that the absorption-spectrum of chlorophyll as contained in the living leaf is always different from that of chlorophyll in solution. This result, we must remark, contradicts the statements of former observers. Dr. Reinke gives a drawing of the spectrum of light which has passed through living leaves. We notice here two main absorptions, separated from each other by a minimum which lies at the wave-length 550. In the original illustration the absorption-spectra of different strata of the leaf are drawn one above the other, so that they unite to form a picture of the increase of the absorption with the number of the ab-

sorbing strata. The absorption-spectrum of an alcoholic solution of chlorophyll is given by way of comparison.

If we disregard the more highly refractive portions we find in the spectrum of a leaf only the band I., as broad as the bands II., III., and IV. appear in the spectrum of the solution. If we superimpose three leaves upon each other, I. becomes considerably broader than in the spectrum of the solution, II. and III. appear faintly indicated, whilst IV. is still wanting. If we use five leaves, I. appears twice as broad as in the solution, whilst IV. comes up as a faint shade. With six or seven leaves it becomes more distinct, but disappears again in the spectrum of eight or nine leaves.

The spectrum of living leaves is thus essentially distinguished from the spectrum of the solutions of chlorophyll by the comparative feebleness of II. and III., and by the quite rudimentary character of IV. These facts show that the chlorophyll of solutions is chemically not identical with the chlorophyll of living leaves. In other words, the latter, when taken up by any solvent, always undergoes a chemical change. Comparative experiments show that the effect of treating chlorophyll with a weak acid consists mainly in an increase of the strength of the band IV. Hence we are led to the conclusion that chlorophyll, as it exists in solutions, corresponds chemically to chlorophyll modified by acids.

The difference between these two kinds of chlorophyll, as observed in the absorption maxima, may be traced also in the minima, which lie between the wave-lengths 720—700 in the extreme red, and between 560—540 in the green. In the absorption-spectrum of leaves the red did not disappear until the light had been passed through a stratum of sixteen leaves. The green was perceptible even through a layer of eighteen leaves, whilst it is more strongly absorbed by concentrated solutions.

Though Dr. Reinke comes, in the points above mentioned, in collision with the results of earlier experimentalists, yet, as regards the fluorescence of the chlorophyll of the living cell, he agrees with the majority of observers. He finds the chlorophyll of living leaves non-fluorescent, whilst, as is well known, solutions of chlorophyll display a very fine red fluorescence. Reinke explains this fact by the consideration that the chlorophyll in the leaves does not exist in a state of solution. The absence of fluorescence depends, consequently, on the state of aggregation of the chlorophyll. That its condition in this respect is decisive may be learnt from the following experiment :—Chlorophyll obtained from

a recent alcoholic extract was dissolved in melting paraffin, and displayed the same intense fluorescence as in the alcoholic solution. On allowing the paraffin to cool, when it congealed to a transparent cylinder of a uniform green colour, it did not possess the slightest fluorescence, which, however, returned on melting the paraffin. Hence it would follow that chlorophyll is present in plants in the solid condition, and not in solution.

The colour in which leaves appear to us is green. The light reflected by leaves consists, as both Reinke and Lommel have found, of the same radiations which have passed through a single leaf,—*i.e.*, the extreme red nearly as far as B, and the rays between C and E, in moderate intensity, whilst the dark green and blue are only faint. A spectroscopic examination of the sunlight reflected from illuminated leaves shows the absorption-spectrum of chlorophyll very distinctly. That a light which consists of red, 720—700, and green, 540—520, should appear to us green is explained by Reinke by the consideration that our retina is much less sensitive to red than to green, and whence the former is less prominent in the general sensation.

These remarks on the light reflected by foliage and grass may, perhaps, explain an anomaly in the sphere of art. Landscape-painters generally find the green of trees and fields a very difficult colour to reproduce to their satisfaction. Again, we admire the effects produced in Nature when blue flowers—such as the wood-hyacinth, the harebell, the gentian, or the forget-me-not—appear in close juxtaposition with the green of leaves. Yet we find that in the decorative arts it is not easy to combine blue and green advantageously. We may now see the reason for these anomalies. Our green dyes and pigments differ widely in their optical composition from chlorophyll.

Dr. Reinke, in passing to the important question of the relation of living chlorophyll to the assimilative process, points out that the colour—*i.e.*, the impression which the leaf of a plant makes upon our eyes—bears no relation to the reduction of carbonic acid. On the contrary, we have here to consider exclusively those luminous undulations which are absorbed by the leaf, since only light which is absorbed can be transformed into any other form of energy within the absorbing body. Earlier observers have not overlooked this point. Thus Dr. Lommel concludes that the maximum of the reduction of carbonic acid, and the absorption of carbon, coincides with the absorption-maximum I. of the spectrum of chlorophyll. He conceives that each

molecule of a body is, so to speak, attuned to a certain number of vibrations, and when it is struck by light waves, vibrating in unison with it, these waves give off their *vis viva* to the molecule, the light is absorbed, and its *vis viva* performs chemical work. As, however, the number of vibrations plays a certain part in chemical action, as is proved by the behaviour of silver chloride with the violet rays, it is possible that the rays of shorter undulations are of importance in the process of assimilation. Hence Lommel's conclusion that the maximum of assimilation coincides with the maximum of absorption I. can only be regarded as a probability resting on theoretical considerations.

Prof. Hoppe-Seyler has also pointed out that emissions and absorptions of light are effected not by the entire molecule, but by atoms and groups of atoms. As the greatest part of the sunlight which impinges upon a solution of chlorophyll is converted into red fluorescent light of the wavelength of the spectral region between B and C, the atomic group which emits this fluorescent group must be freely and widely movable. The supposition lies, therefore, near at hand that it is this atomic group which splits off oxygen in the living plant.

Experiment, alone, however, is entitled to give a valid and final answer to this question. Assuming that the liberation of gas by *Elodea Canadensis* gives an expression for the intensity of assimilation, Dr. Reinke shows that the maximum of assimilation lies between B and C, falling off very abruptly towards the less refrangible side, and also, though more gradually, on the refrangible side. In the less refrangible portion of the spectrum the curve of assimilation runs almost parallel with the curve of absorption if we overlook the two smaller maxima of absorption II. and III., which latter seem to be as unimportant for the decomposition of carbonic acid as is the absorption in the violet ray. The author arrives, therefore, at the following conclusion :— Assimilation appears, in accordance with the corresponding course of the curves, to be a function of absorption in that atomic group in chlorophyll, and in all its more immediate products of decomposition readily absorbs the rays between B and C, and in a dissolved state emits rays of the same wave-length as fluorescent light.

Dr. Reinke gives a theoretical explanation of this experimental fact. He holds that the atomic group ($\gamma$) of chlorophyll, on the activity of which depends the decomposition of carbonic acid, is inclined to oscillate with the velocity of 440 to 450 billions per second, and is most readily set in

motion by rays of this rate of vibration, whilst rays of either greater or less refrangibility do not produce this result.

Assimilation, therefore, is a function of the undulatory power of the atom in the atomic group, and of the chlorophyll molecule,—that is, of its chemical activity. As it is also a function of the light-rays of that number of oscillations which can set this atomic group in motion, we may say that chlorophyll assimilates the *vis viva* of light, transforming it immediately into atomic vibrations, on the energy of which the splitting up of the carbonic acid depends; the chemical work of the reduction process is only indirectly supplied by light.

We may conceive that the vibrations of the atomic group $\gamma$ are not first produced by light, but that they take place also in the dark, though of too small amplitude to effect the work of assimilation. Light increases this amplitude, and is a condition even for the smallest decomposition of carbonic acid. The result of the chemical process increases then in proportion to the increase of the intensity of light up to a maximum value of the vibratory amplitude, which cannot be further augmented by an increased illumination.

Whether the chemical action of the group $\gamma$ in the process of assimilation is direct or indirect, is not decided by what has gone before. That the latter alternative is possible appears from the researches of M. Becquerel, which prove a very interesting indirect action of chlorophyll. Whilst silver chloride is decomposed only by the so-called photographic rays of sunlight, M. Becquerel observed, in a mixture of silver chloride with chlorophyll, the separation of metal in those parts of the spectrum which correspond to the absorption-bands of chlorophyll.

Dr. Reinke further discusses the relation of assimilation to fluorescence, and puts forward the view that we have here two reciprocal phenomena which may even be mutually exclusive. The green cell would not assimilate if its chlorophyll was fluorescent. Fluorescence occurs with great motility of the chloroform molecule in solution. In solid chlorophyll the transformation ensues in another direction,—that is, in the reduction of carbonic acid, when the chlorophyll occurs in the living cell, and when carbonic acid is present.

## IV. "TECHNICAL TRIALS."

By An Old Technologist.

WITHOUT any fear of contradiction, it may be said that of all the proceedings in our Courts of Law the least satisfactory are so-called technical trials, —*i.e.*, cases, civil or criminal, where the question at issue turns upon some point in the physical sciences or in the industrial arts.

Of such "technical trials" there are several varieties. There are—not often, indeed, though if we are to believe that celebrated "amateur chemist" the Home Secretary, less frequently than there should be—trials for murder or malicious injury by poisoning; there are actions for nuisances and for infringment of patents; there are investigations respecting explosions, the shortcomings of machinery, and the defects of buildings, all of which require for their right adjudication a special acquaintance with chemistry or physiology, or physics, or mechanism, as the case may be. In such trials knowledge of this kind is too often conspicuous by its absence, alike in judge, jury, and counsel. I have no wish to disparage either of these three divisions of the *personnel* of our Law Courts. Our juries, if somewhat—like Englishmen in general—too easily swayed by rhetoric, are doubtless fully equal to the duties ordinarily required of them. As far as common sense and a knowledge of men, of the world, and of business will go, they may be safely trusted. But all these qualifications, joined to the most sterling desire to do even justice are simply as naught in cases of the kind I am discussing. They have to deal with evidence which to them is often as unintelligible as if it were conveyed in some foreign tongue.

Nor is the slightest advantage gained if a special is preferred to a "common" jury. On the contrary, a body of twelve esquires or merchants may prove more at sea than would an equal number of artizans.

Our judges and barristers, in general, well deserve the epithet of "learned," which the courtesy of reporters rarely omits to bestow. In law itself, in history, politics, ethics, and in the classical languages their erudition is not to be challenged. But, as a rule, their acquaintance with physical science and industrial art is neither remarkable for its extent, its depth, or its clearness. Exceptions doubtless

occur. There is, I believe, at present one judge upon the bench who is fully competent to deal with scientific evidence. But we shall the better understand the rarity of such qualifications if we remember that a brilliant and versatile Lord Chancellor, concerning whom it was said that "he would have known a little about everything if he had only known a little law," proved, by his pitiful critique of Young's researches in optics, how infinitesimally little was his knowledge of physics. I fully recognise the ability which counsel often display in "reading up" some subject which is involved in any case they may have in hand. But the knowledge thus acquired is often deficient in clearness, and is sometimes more adapted for baffling a supposed hostile witness, or for bewildering a jury, than for arriving at the truth. It may, perhaps, be questioned whether the entire training of a lawyer is not (unless he has made a special study of some department of natural science) liable to give him a bias which is here to be regretted. He is accustomed to search for truth not in things, but in words, spoken or written, and he consequently is apt to lose the power of learning from things. He is also, in his ordinary sphere, necessarily swayed by authorities. Hence in "reading up" for (say) a poisoning case he attaches an exaggerated importance to the works of Christison or Orfila, of Liebig or Fresenius, even when visible and palpable facts are much the safer guides.

Having thus dealt, as I fear some will think rather uncourteously, with the bench, the bar, and the jury-box, I come to the experts summoned as witnesses. I saw, some little time ago, in this Journal, the alleged dictum of a judge that while he had "a great respect for professional witnesses, he had none for witnesses by profession." Now of all men concerned in a technical trial the expert witness is placed in the most radically false position. He is supposed to be, like every other witness, the partizan of the side by whom he is called. Often—too often, indeed—he is so in reality. Hence comes the scandal, with which we are all but too familiar, of scientific men contradicting each other in a manner little creditable to Science, and certain to lead any impartial hearer to one of two very derogatory conclusions. "Either," it will be, and it has been said, "Science can lay but little claim to certainty, and is rather a mass of doubtful speculation than a body of demonstrable truth, or else these experts are men who for a fee will say anything." No one I fear can read, *e.g.*, the report of the trial of Palmer, or of the great Torbane Hill case, without entertaining very painful reflections. In fact, some of the most eminent scientific men

systematically refuse to undertake any investigation which may ultimately compel them to give evidence before a Court of Law. They decline to accept a position which may subject them to insults for which neither the law nor public opinion gives them any redress. No less do they object to be supposed capable of wresting the truths of Science for a fee, or to serve the interests of any man. Hence it frequently happens that the public lose the advantage of having those truths, as bearing upon the case, expounded by the highest authorities.

But how is this unsatisfactory condition of things to be amended? A recent writer proposes that for such trials there should be a new and distinct kind of jury empanelled, consisting of men more or less acquainted with the physical or natural sciences, and accustomed, in virtue of their calling, to observe facts and to draw thence accurate conclusions.

Such "more special" juries should consist of medical men, pharmaceutical chemists, engineers, chemical analysts, works' chemists, architects, &c. It is urged that at present much time is wasted because the jury do not understand the technicalities of the case. If we suppose a trial concerning the novelty of a machine. The language in which its different parts and their movements are described is to the twelve good and true men,—whether "common" or "special"—about as intelligible as if it were given in choice Sanskrit. The jury do not clearly understand the professional witness. What makes the matter worse is that, very often, counsel is in the same predicament. Further, one of his ordinary functions is, if he cannot confuse the witnesses called on the opposite side, at any rate to prevent the jury from forming a correct opinion as to the facts brought forward, and as to the conclusions to which they point. Now, it is submitted, that a jury of the new proposed kind would have at the very outset a serious advantage. They would understand the technical language used; they would be able to decide, of their own knowledge, whether the evidence given on either side was in accordance with known facts and with established theories, and they would see directly and not through the somewhat perturbing medium of counsel, to what conclusions such evidence pointed. It is further submitted—and not without a certain amount of truth—that, before such a jury, expert witnesses would be exceedingly cautious in advancing nothing of a doubtful nature, and would simply tell "the truth, the whole truth, and nothing but the truth," according to their belief and knowledge.

But admitting all these advantages of the new technical juries, I must still point out some grave objections to the proposal. In the first place, medical practitioners and pharmaceutical chemists are at present by law exempt from serving on juries, and that for reasons which must at once commend themselves to the common sense of the public. The great body of chemists and druggists are claiming the same exemption, and on the very same grounds. It is not likely that these numerous and organised bodies would willingly forego their present or hoped-for immunities, and consent to act as jurymen in what are often the most tedious cases. If, then, they could not be counted on, it would often, in country districts, be difficult to find a sufficient number of persons qualified to sit on a technical jury. Engineers, architects, works' chemists, analysts, college professors, &c., would, further, be fairly entitled to claim exemption from serving on ordinary juries, if made specially liable to this kind.

A far more important point is that unless special care were exerted in selecting such a technical jury, it would not have the advantages sought for. Let us, *e.g.*, suppose a trial for an alleged infringement on a patented improvement in locomotive engines. The court has summoned at random a sufficient number of persons from the technical jury-list, and when the trial begins the panel is found to consist of physicians, surgeons, a chemical analyst, and a professor of botany from ——— College. In this very possible case, where will be the advantage as compared with an ordinary or a special jury? The jurymen will be as ignorant of the technical language of the subject before them as would be an equal number of "esquires or merchants." They will not know, of their own knowledge, whether the statements made by witnesses are in accordance with recognised truth or not. They will still require to have the facts elicited explained to suit their comprehension, and they will thus be liable to be led astray.

I take another case: Suppose Palmer being tried over again. Let the jury comprise four medical men and two chemical analysts, but let the residue be made up of architects and engineers, with a professor of geology. Here, again, the advantages would be problematic. The first six would understand the technical language of the case. They would be able to sift for themselves the evidence offered. The physicians would know the meaning, *e.g.*, of certain symptoms deposed to as having been observed before death, and of certain appearances noted during the *post mortem*

examination. The analysts—and to a certain degree the physicans also—would be able to judge whether the best known processes had been employed for the isolation and recognition of the poison, whether all necessary precautions had been taken, and whether the reactions obtained were conclusive. But the engineers, architects, and geologists would have little or no advantage over an equal number of country gentlemen, bankers, merchants, or even retail tradesmen. They would not understand the technicalities of the case; they would not know the meaning of symptoms and reactions. Hence this portion of the jury would be open to be led astray by the statements of experts and the appeals of counsel, and on retiring to consider the verdict they would need to be put right by their specially-qualified colleagues.

I shall not, I hope, be accused of hypercriticism if I go a little further. It is commonly supposed that a qualified medical man is competent to give an authoritative opinion on any question falling within the wide and somewhat ill-defined boundaries of "medical science." This, however, is by no means the case. A professional man of standing, summoned on such a jury as I have been supposing, might happen to be a specialist in mental alienation, in gynæcology, in affections of the eyes, or he might be what is technically called a "pure surgeon," skilful and experienced in operations. Such physicians or surgeons might easily happen to have had absolutely no experience at all in cases of poisoning, whilst their chemistry may have been allowed to rust in peace since the day when they passed their examination. Such men, I submit, will be of no special use in the trial of a poisoning case.

I may go still further: Among analytical chemists of recognised learning and ability, there are many who never have concerned themselves with toxicology. They may have, *e.g.*, extensive experience in metallurgy, in the chemistry of dyes and colours, or in that of fermentation, but they would be unable to decide, without "reading up," whether certain reactions described by an expert witness were conclusive evidence of the presence of strychnine in an organic mixture or not.

Thus as we examine more closely the benefits to be derived from a technical jury they seem to become fine by degrees and beautifully less.

There is yet another difficulty, perhaps the most serious of all. I refer to professional jealously, which would here come seriously into play. This element, I admit, is not

entirely absent under the existing system. It is not for me to take up the published reports of any celebrated trial, and say that such or such an opinion given by Dr. B. in the witness box was more or less dictated by private ill-will to Professor A., who had been called by the opposite side. Yet at the time of some of the great poisoning trials there prevailed an uneasy suspicion, both in medical and legal circles, that some of the evidence given had been at least coloured by this unworthy feeling. But, under the proposed system, there would be, as it seems to me, three channels through which professional jealousy might make itself manifest. Experts between whom there is "no love lost" might still, as now, be called to give evidence by the opposite sides. Or, again, suppose a trial where the issue is the pollution or the non-pollution of a certain well. In the witness box stands Professor X., who states that he has analysed the water by his own method, which he maintains is the only trustworthy process known, and that he has found such and such results. In the jury box sits his rival Professor Y., who declares that the method used is utterly worthless, the amount to be determined being smaller than the limit of error, and that a certain other process ought to have been employed. Should we not then have the jury cross-examining such a witness in a more offensive and imputative manner than is now done by counsel? In the third place let us suppose our two rival professors both on the jury, scarcely to be kept within the bounds of public decorum, whilst counsel seek to foment the quarrel. Let us imagine the scene afterwards, when the jury retire! In all probability they would be discharged as unable to come to any decision, and a new trial would become necessary.

There are, however, cases where a jury of experts, in a form perfectly practicable as the law now stands, would be extremely useful. I will take the following instance, no mere apologue or parable, but, save for the suppression of the names of persons and places, an actual fact:—Messrs. C., dyers, sued Messrs. E., another firm of dyers whose works were situate higher up on the same stream, for injury done to their trade by the pollution of the water with waste dye-liquors, &c. The case was tried in London, and there was an immense outlay incurred in bringing up witnesses, analysing samples of the water above and below the point where the pollution was said to have originated, and the final result was a compromise. Now, if the case could have been tried on the spot before a jury of dyers, who could first have inspected the stream and then adjourned to the dye-

houses and seen the work which was being done with the alleged "polluted" water, they would in a few minutes have been able to reach a more exact conclusion as to the injury sustained than all the chemical and spectroscopic analyses brought forward, and all the orations of eminent counsel could or did lead to. This case, doubtless, might serve for a type of many in different arts.

I may be asked, since the scheme of technical juries does not appear to me totally unobjectionable, what remedy I should propose? My plan is very simple, and has to some extent been already tried. Let the experts not be "called" by either plaintiff or defendant, or indeed act as witnesses at all, but let them be appointed by the court as assessors to the judges. Just as the latter gives an authoritative exposition of the law of the realm as bearing upon the case at issue, so these experts would expound to the jury the conclusions of Science as bearing upon the case. They would be under no temptation to speak as partisans, since the success of either party would be to them absolutely immaterial. They would be exempt from either examination-in-chief or cross-examination. Consequently there would be nothing to deter men of the highest eminence from giving the court the benefit of their knowledge and experience. The jury would receive their opinions continuously, not in the fragmentary form of a catechism, and counsel on either side would have no scope for perverting their utterances or making them unintelligible to the jury. Finally, I would recommend that in all such cases as nuisances, machinery, manufacturing processes, &c., the Court should adjourn to the very locality and to the objects concerned, and see, as far as possible, with its own eyes, which would save much talk.

As I have been discussing the composition of juries, I may, perhaps, indulge in a few remarks not strictly relevant. It is well known how women are gradually asserting their rights to a share in certain functions formerly deemed to pertain solely to men. They have obtained the power to vote in certain municipal and local elections, and to take their seats, if elected, on a variety of Boards. They are now demanding the Parliamentary franchise, and seats in the House soon will follow. But I never hear of them claiming to serve on juries. Is it that they draw a hard and fast line between what are commonly called "rights" and "duties," political or municipal, and that whilst eager for the former, they are quite willing to overlook the latter?

## V. THE HEALTH EXHIBITION.

ONCE more South Kensington—the concrete, not the abstract—is *en fête*, swept and garnished. Once more she has thrown open her gates; and the exhibitor and the getter-up of exhibitions, the critic and the would-be purchaser, the lounger and the consumer of refreshments err through her mazes.

After a first and not un-admiring glance at the varied and animated scene, our next thought was astonishment at the ingenuity displayed by exhibitors in bringing their articles into some sort of quasi-connection with public health. We feel convinced that if that often-cited personage, the "intelligent stranger," could be suddenly transported from the ends of the earth and set down in one of the courts or the galleries without having seen any of the advertisements or prospectuses of the display, he would be utterly unable to guess that it was in any especial way connected with health. Let us take the entrance-hall devoted to food-products. That food is a very important factor of health no one will dispute. But what do we see here? There are certainly some most interesting exhibits. The stall of an Austrian Vineyard Company displays the dreaded *Phylloxera* in its different stages of development, and roots of the vine suffering under the visitation. There are also specimens of wines undergoing morbid changes. There is another stall showing the varieties of coffee grown in different soils and climates. There are similar exhibits of teas. Here the public will find something to learn and remember. Very near at hand is the display of the British Bee-keepers' Association. Here we see preserved specimens of Ligurian, Syrian, and Cyprian bees, hybrids, queens, drones and workers, fruitful workers, and the progeny of the latter. There are cells of each class of bee in the successive stages of development of the larvæ. There are, too, specimens of honey. One kind, of a whitish colour, was labelled as collected exclusively from white clover. Another, of a peculiarly rich golden tinge, was from lucerne,—a plant dear to every entomologist, on account of its attraction for numbers of insects. Still we feel a little doubt as to how the bees can be persuaded to devote themselves entirely to one kind of flower.

But in this same food department there was also much neither novel nor instructive, and which can only be regarded in the light of an advertisement. Piles of tins of condensed milk, of Australian meat, and of preserved vegetables can be seen in many shop-windows. "Animals from the London markets," stuffed, convey also little instruction. In one display of this kind, belonging to a taxidermist,—or, as our friend Mr. S. Butler would say, to a "man who seasons the skins of owls,"—there were actually a huge stuffed dog and a puppy. This display may perchance lead foreigners to believe that John Bull, like John Chinaman, regales himself upon "stewed bow-wow," or that the youth of the "period" indulge in cannibal repasts of puppy-pie. New sources of food do not form a prominent feature, human ingenuity having perhaps already tried everything available.

Adulterants, substitutes—or, as our German neighbours facetiously call them, "surrogates"—for various kinds of food, were not wanting. Thus we saw, on the stall of a Dutch exhibitor, the word, and the thing, of ill omen, "margarine boter," and the question rose to our minds whether this sample and the bulk which it represents had undergone any treatment certain to destroy microbia.

Along with coffee there was its simulacrum chicory, which, in spite of Viscount Halifax and Mr. Gladstone, we must persist in regarding as an adulteration. Why is not tea, in like manner, exhibited and sold as "mixed with a portion"—modest word!—of the purest slow-leaf? There was a stall of preserved fruits manufactured in Gloucestershire under improved auspices. The fruit goes direct from the orchards to steam-jacketted pans, and receives no admixture save the finest lump-sugar. Whilst giving our tribute of applause to the nobleman who in this manner finds employment for a number of persons, and a remunerative use for some hundred acres of land which might otherwise revert to the barbarism of "permanent pasture," we should like to ask whether the sugar used is real saccharose or only "betose"? An exhibit showing the physical differences between these isomeric bodies would have formed an interesting feature.

In what are commonly called sanitary inventions the Exhibition is fairly rich. There are devices for preventing the scullery-sink from being blocked up with congealed fat. There are effluvia-traps and soil-pipes of various kinds. But we fear that no syphon, however constructed, can prevent the sewer-gases from interchanging through the water with the air of the house. There is an apparatus which is

to get over, or round, the sewage difficulty by carbonising excreta and refuse generally in a special furnace, and using the gaseous products to light the house. We fear such gas, whatever its "candle-power," would be slightly mal-odorous, and should dread the occurrence of an escape. We scarcely see, however, how this device is to deal with urine, soap-suds, &c., which are generally more offensive and dangerous than the solid refuse of a household.

The electric light may safely claim a place in a Health Exhibition, since if adopted it will deliver us from the sulphurous acid, sulphuretted hydrogen, carbon monoxide, &c., which coal-gas diffuses in our dwellings.

Cooking-implements influence our health to no small degree. We were therefore pleased to see pans enamelled with a composition warranted free from lead or any other poisonous metal. In like manner pans lined with nickel and aluminium deserve commendation. But copper and brass pans, bare within, or lined with what is by courtesy called tin, but which is in deed and in truth an alloy of tin and lead, were still there, in full despite of modern medical and chemical science. We cannot here help recommending all whom it may concern when about to purchase any utensil lined with tin, to rub its inside with a bit of clean white paper: if the paper is at all blackened lead is present, and the best policy in that case is briefly conveyed by an emphatic *don't!*

Furniture and appliances for the sick room are not wanting, and seem constructed on very satisfactory principles. Everything of wood is of a light colour, and is thickly coated with a varnish, so that there may be no possibility of the absorption of anything of an offensive or infectious character, liquid or gaseous. We noticed in this department a small cupboard, beautifully lined with a white enamel.

Stoves and ranges of the most varied character are to be seen, both for warming and for cooking. Many of the former, though tasteful and worthy of notice from an æsthetic point of view, have no perceptible sanitary bearing. One of the most pleasing in appearance is the "Nautilus stove," which is shown in several sizes. Whether it does not throw too much of the radiant heat upwards, instead of down upon the floor and the feet of the occupants, is perhaps doubtful. Some few of the cooking-ranges have the oven heated from below, on the sensible plan general in the north of England. Kitcheners manufactured south of the Trent generally have the cardinal faults of using a small bulk of fuel at a very high temperature.—which is necessarily wasteful,—and of applying the heat from above.

Among gymnastic appliances we may mention *Z*ander's arrangements for the movement-cure, as in successful use in the well-known establishment in Soho Square.

Certain model-houses were not complete at the time of our visit. In this important sphere we have still very much, if not to learn, yet to put in practice. So long as the short building-leases customary in London are tolerated, and so long as a number of persons can squeeze themselves in between the land-owner and the tenant, so long will "jerry-work" in building prevail, and even increase.

It is generally owned that, as far as a picturesque effect is concerned, our domestic architecture has greatly fallen off since the days of good Queen Bess. But it is sometimes asserted that, as far as healthiness is concerned, it has as distinctly improved. This is a flattering delusion. We have, indeed, abolished domestic cesspools; but their modern substitute, the water-closet, is often so carelessly constructed that it may be called an arrangement for supplying to every house sewer-gases and the microbia which they hold in suspension. We have sewers, which the olden time had not; but they are brought right under the floor of our dwelling-rooms, and between their imperfect and leaky surfaces and our noses there is sometimes merely the flooring. Nay, it even happens that the soil from our water-closets and the slops from our sinks do not find their way completely into the main sewer, but escape through defective connections and stagnate about the foundations. In such cases the abolition of the cesspool is merely a change of names, not of things.

Again, look at the walls dividing room from room. In the days of old they were built of brick and mortar; now they are merely hollow shells of lath and plaster, affording a secure retreat and breeding-place for cockroaches, mice, and rats, where the excreta of these vermin and portions of food which they carry off accumulate and decompose, and where disinfectants and ventilation are alike inapplicable.

Again, how is mortar—at least as used by the London building speculator—composed at present? Not as it used to be, and as it ought, of sand and lime. In any suburban region the surface-soil—it may be that of a recent market-garden, highly manured—is made to do duty for the former! What of the beams, the flooring, and other wood-work in the semi-detached villas and "desirable residences" advertised as to be let or sold? Is it fresh, wholesome timber from Norway or Canada? No; houses in the slums, which may have been inhabited by successive generations of diseased

and filthy inhabitants, are pulled down, and their woodwork, after being slightly dressed over, is used in the erection of new, pretentious, and highly-rented structures. Whether such wood is or is not saturated with the poison of small-pox, of scarlet fever, or of typhus, the building speculator never cares, and the purchaser or the tenant has no means of knowing. These evils cannot be illustrated in any Exhibition. If they could it would make a far stronger impression than any lectures, articles, or letters.

From the sins of the builder we may pass to those of the tailor, the modiste, and the shoemaker. Here, again, is much that cannot be exhibited. Charles Kingsley told us, and modern authorities have enforced the sad tale, how the superfine garments which Society buys at some fashionable establishment have been made in the den of some sweater, reeking with disease; may even, whilst unfinished, serve to cover the bed of the dying, and may thus convey infection to their wearers. How could such grim facts be brought clearly home to the public?

Some of the effects of tight lacing and of high-heeled boots might be rendered palpable by means of anatomical models; but if this has been done in the present display it has so far escaped our detection.

We miss likewise any attempt to familiarise the public mind with cremation as a means of disposing of the dead. A display of the gas-furnace contrived for this purpose, and an occasional demonstration of the rapid and inoffensive manner in which nitrogenous matter is thus decomposed, would have been useful.

The greatest cause of the debility of these days—the influence of worry and overwork under the pressure of anxiety—cannot be exhibited, and if it could be we doubt if the exposure would be sanctioned.

The entire Exhibition, as a matter of course, has not been collected on the principle of displaying all the various causes which tend to undermine human health and vigour, and the devices which have been hitherto adopted for their removal. It is a promiscuous gathering of whatsoever articles can be looked on as connected with health, and its central idea seems to be that of advertising.

## ANALYSES OF BOOKS.

*A Dozen Papers relating to Disease Prevention.* By CORNELIUS B. FOX, M.D., F.R.C.P. Lond. London: J. and A. Churchill.

THE first of these papers discusses a subject of manifest national importance—the "Impairment of the Efficiency of the Medical Officer of Health produced by his want of Independence as a Public Official." That such an impairment must occur might well be admitted *à priori*, but the author adduces facts by which it is superabundantly proved. If the medical officer is a general practitioner, he cannot do his duty without giving offence, and thus losing his patients. If he advises houses to be closed as unfit for human habitation, or if he condemns meat, &c., in the market as dangerous to health, powerful local interests are aroused against him.

Dr. Fox denounces the Public Health Act of 1872 as radically unsound, "attaching as it did public health to poor-law work." Here he is perfectly right. The average poor-law guardian in England, and, we fear, still more in Ireland, is a half-educated being, who knows nothing of sanitary matters and does not care to learn. But if the medical officer is not in practice, but receives from a combination of districts a salary which might make it worth his while to give his whole time to his duties, he is scarcely in a better position. If he tells the truth, the district which he denounces threatens to withdraw from the combination —as the law unfortunately permits it to do. He has thus no tenure of his office, and unless he is prepared to sacrifice himself for the good of the public, his obvious policy is to shut his eyes, issue delusive reports, and—quietly draw his salary.

Much of what Dr. Fox here says we can confirm from our own observation. We know cases where the medical officers of health of considerable districts receive mere nominal salaries. They have been appointed as a mere nominal compliance with the law, with the express understanding that they should do nothing!

The paper on "Coke as a Fuel in relation to Hygiene" is the more important, as what is said applies equally to anthracite, which has been unduly extolled as a means of getting rid of the smoke-nuisance. The public labour under the error of supposing that the chief evil of smoke is the visible blackness. Admitting the unpleasantness of soot-flakes, we must still maintain that its worst features are unseen,—sulphurous acid and carbon monoxide,

formerly known as carbonic oxide. This gas, as Dr. Fox shows, is a fearful poison; it is produced during the combustion of coke, and it permeates heated cast-iron. It is a strange thing that we cannot in this country obtain stoves of glazed earthenware, and thus economise fuel without inhaling a narcotic poison. The author remarks that "the sun, burning coal, burning wood, hot-water pipes, and stoves, give forth heating rays which can by some be distinguished in virtue of a difference in the impressions afforded." That such should be the case is, theoretically speaking, to be expected, but we fear that few persons could be found sufficiently sensitive for the study of these variations. Perhaps experimentation on plants or on certain insects might show whether there is any difference in the physiological action of heat obtained from difference sources.

In an essay on the supply of rain-water to cottages in rural districts, Dr. Fox combats the arguments brought forward on behalf of hard water as a domestic supply. He quotes Dr. Cameron to show that the death-rates of Glasgow and Manchester, and other towns supplied with soft water, were not lower when the water furnished to them was hard, and that the public health of Dublin has improved since the substitution of the soft water from the Vartry for the hard-water with which that city was formerly provided. Dr. Fox's own experience leads him to the conclusion that a water of moderate hardness is preferable to either a very soft or a very hard water, and that a very soft water is preferable to a very hard one.

On the pollution of rivers, Dr. Fox takes a view mid-way between the advocacy of neglect and the sensational and impracticable policy of the defunct Royal Rivers' Pollution Commission. He quotes, approvingly, the dictum of the Duke of Somerset—"The foul matters encumbering streams may be got rid of, but the notion of their supplying water fit to drink must be altogether put aside." For our own part we have very rarely found the water of a lowland river fit to drink, even in uninhabited and uncultivated districts.

Concerning the degree in which various kinds of fish are affected by polluted waters there is much diversity of opinion. The author states in a note that "the gudgeon is said to be more liable than any other fish to be influenced deleteriously by impure water." We have heard the same view expressed in other quarters. Yet the late Frank Buckland, in his "Natural History of British Fishes," says that gudgeon are very fond of living in sewer water which would be immediately fatal to a trout or a salmon. Perhaps in reality the death of one species of fish, or the survival of another, depends more upon the kind than the mere quantity of the pollution.

Dr. Fox denounces, very justly, the common practice of depositing solid refuse on the banks of rivers where they may be carried off by floods. To this practice is due, to no small extent,

not merely the silting up of streams formerly navigable, but the increase of floods—one of the many evils with which our farmers have to contend.

Two important papers, "Is Enteric Fever ever Spontaneously Generated?" and "The Dissemination of Zymotic Disease among the Public by Tradespeople," suggest reflections not altogether pleasant. It must be admitted that we have in these enlightened days agencies for the transmission of infectious diseases unknown to our forefathers. Our public conveyances, our loan libraries, our distribution of tracts and circulars, and (if we may presume to utter such heresy) our School Boards, are all admirable devices for this purpose. It seems that according to the existing law a shop or a publichouse may remain open whilst there is zymotic disease on the premises, and the very persons who nurse the sick may attend to customers. We remember being much shocked, about twenty years ago, at discovering that in a back room, separated from a shop merely by a curtain, there was a case of malignant typhus. But the facts stated by the author—far too many for us to quote—are, if possible, even worse. He has detected a dairyman washing out cans with "most offensive sewage-water," and milking his cows into a pail which resembled a filthy pigs' bucket. He asks why dairies cannot be placed under sanitary inspection as well as slaughter-houses? Why indeed?

We should strongly advise all who wish to have healthy homes to read Dr. Fox's little pamphlet. They will then see that as long as things remain in their present condition there is small cause to wonder if small pox, scarlet fever, and the like penetrate into families where, as far as is known, all the conditions of health are observed.

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*The Principles and Practice of Electric Lighting.* By Alan A. Campbell Swinton. London: Longmans and Co.

This work, the author tells us, is intended to meet the wants of persons who use, or wish to use, the light, and of "the general scientific public who take an interest in all new discoveries and inventions." He avoids therefore, as far as possible, technicalities, and describes merely such machines and appliances as are of approved practical value.

After an Introduction, in which the apparently slow progress of electric lighting is discussed, Mr. Swinton considers the theory of electric lighting, and explains certain technical terms which are practically indispensable. He then proceeds to an account of electrical, mechanical, and photometrical measurements. The

Bunsen photometer is of course recommended as preferable to that of Rumford, but no standard unit is suggested as more constant than the English candle and the French carcel.

Among sources of power wind is omitted, doubtless from its inconstancy. In the fifth chapter, which treats of Dynamo-electric Generators, the most efficient machines of the day are described and figured. It is prophesied that the dynamos of the future, "though they may not be very much more efficient than those of the present day, will probably be of much larger size and of simpler construction"—a very safe forecast.

The two next chapters treat of Arc-lamps and of Semi-Incandescent and Incandescent Lamps, the advantages of the latter as best suited for use in houses and other confined areas. Their freedom from flickering is the most important point. According to Sir W. Thompson, for one and the same expenditure of power an arc-light gives ten times the quantity of light which can be obtained from a glow-lamp. In the latter the consumer has to steer his way between two evils. If the current is too powerful the filament is rendered intensely brilliant, and the economy of the light is increased. But the filament is soon worn out, and the lamp quickly becomes useless. If the current is too feeble the lamp will last for a very long time, but the light is feeble and yellow.

"Accumulators," as at present constructed, labour under so many defects that they are employed only where unavoidable. Probably they may be found capable of improvement. In the meantime they serve mainly as a type of the modern English youth whose education consists in preparing for examinations. The secondary battery, like the student, takes up a certain quantity of power, and gives it out again minus a heavy amount of leakage.

The last chapter is one of great practical importance, as it discusses the advantages and the cost of electric lighting. It is interesting to find that in several cases, the particulars of which are fully known, electricity has proved itself a cheaper source of light than coal-gas. The installation which Mr. W. Crookes, F.R.S., has adopted in his house, for the efficiency of which we can bear witness, effects a saving of £4 17*s.* 6*d.* yearly, although the dynamo and the gas engine, from the nature of the case, work under serious disadvantages. An important consideration is that incandescent lamps do not vitiate the air in the slightest. Ceilings are not blackened; books, pictures, upholstery are not injured, and the risk of fire is decreased.

We think that this little book will encourage many persons to try the experiment of introducing the electric light into their houses, and will thus do a good work.

*Thoughts on the Interdependence of Water and Electricity, and Cognate Subjects.* By WILLIAM BOGGETT. London: Ridgway.

IF Mr. Boggett is right our physics and our chemistry will have to be re-constituted, almost from the very beginning. Electricity, we are told, is not a form of energy, but a kind of matter. Water is a compound, not of hydrogen and oxygen alone, but of these *plus* electricity. Such assertions could only be established by very definite experimental evidence. Such evidence the author does not, as we understand him, bring forward. He writes:—"It is inconceivable that any mere *mixture* of two combustible and explosive gases could remain unconsumed when exposed to intense heat, or, if water is composed of them without any other admixture, that the hottest fires could be extinguished by their use." Precisely so; but no chemist contends that water is a *mixture* of oxygen and hydrogen, but a combination, which is quite a different thing. Further, oxygen, *per se*, is neither combustible nor explosive. He writes further, "there is no proof that electricity is *not* in water." This is a perfectly illegitimate line of argument.

We read further:—"As ice floats upon it [water], and consequently is lighter than water, it must have lost some ponderable matter. It had parted with its oxygen, that being eight times heavier than the hydrogen, and likewise with the electricity, which is not present in ice." Here the reader will perceive a collection of errors. Ice is specifically lighter than water, and floats upon it just as solid tin floats upon melted tin—not because it has lost any ponderable matter, but because it has expanded during freezing. The proof of such expansion is known to every one. If water loses ponderable matter in freezing, then a pound of water, if converted into ice, would weigh less than a pound, which has never been observed. The author, further, if we understand him aright, says that water in freezing parts with its oxygen,—an assertion perfectly unsupported by experiments. Had it done so it would not become ice.

Mr. Boggett contends that water is necessary to the production of an electric current. What, then, of the thermo-electric battery, and of the dynamo-machine, now recognised as the most economical source of electricity?

We by no means assert that the orthodoxies of Science are placed beyond question. But whoever comes forward to refute them should at least have given them a careful study, and understand clearly what he is attacking. Now the author formally admits that he knows "next to nothing of chemistry."

*Vichy and its Therapeutical Resources.* By PROSSER JAMES, M.D., M.R.C.P. Fifth Edition. Baillière, Tindall, and Cox.

THIS pamphlet presents little to attract the especial notice of our readers. It gives a description of the Vichy springs, their origin, and the history of the Spa. The account of the neighbourhood is flavoured with a *soupçon* of satire:—"Our Continental friends have either an excessively keen eye for the beautiful, as well as the curious and rare, or a very poor opinion of John Bull's judgment, for they never fail to find something for him to see, and, having seen, to pay for. A house in which some one was born, or died; a ruin which may have been a castle, or may not; a convent, a church,—anything, in short, which can be seen is called a sight, and serves the purpose of extracting a franc from the purse of the credulous traveller."

Next follows a chemical analysis of the waters, which it appears all contain a modicum of arsenic. The present rage for mineral waters—all we believe imported—shows what may be done by persistent advertising. The life-pills led the way and the waters followed.

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*Vestiges of the Natural History of Creation.* By ROBERT CHAMBERS, LL.D. Twelfth Edition, with an Introduction relating to the authorship of the work by ALEXANDER IRELAND. London and Edinburgh: W. and R. Chambers.

IT is hard for men still on the sunny side of their fortieth year to realise the outcry which greeted the first edition of the "Vestiges." It is harder still for those who are now waxing old to look back upon that outcry without a feeling of deep humiliation—shame for our country and shame for our boasted and boastful nineteenth century. For the part taken in this tumult by the churches—the so-called religious world—there was, indeed, slight and scanty cause. For the book denounced, when viewed by men in their sober senses, is found to be, alike in its line of argument, its purpose, and its very title, plainly theistic and at issue with no point of the creeds of Christianity.

But the conduct of a great part of the scientific world of the day is even more to be deplored than is that of ecclesiastics. The late author said, as quoted in Mr. Ireland's introduction:—"I feel embarrassed in presenting myself in direct opposition to so many men possessing talent and information, but I think there are reasons *independent of judgment* for the scientific class

coming so generally to an adverse conclusion concerning my views. As the case really stands the ability of the purely scientific class to give at the present time a true response upon such a subject appears extremely challengable. It is no discredit to them that they are, almost without exception, engaged each in his own little department of science, and able to give little or no attention to other parts of that vast field. . . . Experiments in however narrow a walk, facts of whatever minuteness, make reputations in scientific societies; all beyond is regarded with suspicion and distrust. The consequence is that philosophy, as it exists among us at present, does nothing to raise its votaries above the common ideas of their time."

We fear, however, that much of the opposition which the teachings of the "Vestiges" met with from scientiffc men sprang, in part at least, from motives less creditable than a mere lack of the *esprit d'ensemble*. A novel theory put forward in an anonymous work, or by a man whose reputation is not already established, is, even in these days, by no means sure of a fair hearing. We fear that some of the scientific critics of the "Vestiges" were, in fact, hypocrites who, against better light and knowledge, pandered to ruling error. Upon this subject, however, we cannot enlarge.

The authorship of the work before us was at one time hotly contested. We learn, indeed, from the introduction that, though Robert Chambers was, among not a few others, suspected of being the author, yet "there is in existence an elaborate MS. essay demonstrating that he could not have been the author."

To undertake a review of the "Vestiges" would now be superfluous. Most of the arguments urged against it have been not merely shattered but decomposed, and, as the old alchemists used to say, resolved *in terram damnatam*. We may, however, briefly notice some of the points in which the "Vestiges" differs from the "Origin of Species,"—a difference, as we believe Mr. S. Butler would contend, not always in favour of the latter work. Darwin, as is well known, does not speculate on the primary origin of life. He seeks merely to show how from one or from few species the present rich diversity of the animal and vegetable worlds may have been developed. Chambers argues in favour of spontaneous generation (abiogenesis) as not improbable. It must be admitted that the evidence here brought forward in its behalf is not in accordance with the knowledge of the present day.

In Chambers we find no trace of "Natural Selection" and "Sexual Selection" as agents in the work of Evolution. On the contrary, this development is, in his opinion, the result—"First of an impulse which has been imparted to the forms of life, advancing them, in definite times, by generation, through grades of organisation, terminating in the highest dicotyledons and vertebrata, these grades being *few in number*, and generally

marked by intervals of organic character which we find to be a practical difficulty in ascertaining affinities; *second*, of another impulse connected with the vital forces, tending, in the course of generations, to modify organic structures in accordance with external circumstances, as food, the nature of the habitat, and meteoric agencies, these being the 'adaptations' of the natural theologians."

The difference of this scheme from that of Darwin is capital. With the latter change is constantly going on by insensible degrees, those results only being preserved which prove advantageous to the plant or animal concerned. With Chambers the grades are few in number and, as it appears from an illustration, occur only at long intervals.

It must be further remarked that Chambers, whilst admitting the modifying influence of circumstances, does not accept the theory of Lamarck, that the animal, by constant desire and effort, modifies, if not its own individual structure yet that of its race, and is thus its own contriver and adapter. This view Chambers pronounces "so far from being adequate to account for the facts that it has had scarcely a single adherent."

In our estimate of the "Vestiges" we must not forget that its author overleaps at once the fancied barrier at which Darwin so long hesitated, and recognises that "the force and tendencies of their (man's) illustrious nature once lay imperfectly developed in some humbler form of being."

Chambers's sketch of the affinities and pedigrees of animals contains much which, we may safely say, would not have been written in these days. His somewhat favourable estimate of the taxonomy of Macleay and Swainson seems strange in thsee days.

The "Vestiges" have now, indeed, it may be said, a merely historical interest, but to the thorough-going student of Evolution they will never seem unworthy of attention. We must therefore rejoice at the appearance of the present edition, the more as it clears up all doubt as to the authorship of this once dreaded volume.

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*Compulsory Vaccination in England with Incidental References to Foreign States.* By WILLIAM TEBB. London: E. W. Allen.

THE difficulty of coming to a final decision on vaccination is greatly to be regretted—the more since, behind the simple question of vaccination as a preventive of variola, lies the further question of "vaccinations," if we so use the word, for other zymotic diseases. If Jenner has been a false teacher we fear that Pasteur also is labouring in vain. Hence the issue is one

of scarcely conceivable importance to the human race, and its discussion should, we submit, be conducted in the pure white light of the intellect alone, without appeals to the passions. In this respect we note with little satisfaction a quotation from Mr. John Morley that "when the law comes into conflict with the consciences of men it is law that should be altered, and not the conscience that should be forced." To this dictum we cannot give our assent. There is such a thing as the conscience of a Thug, or of an Inquisitor. Yet the law is bound to "force" these consciences, and to uphold its interference, if needful, with the rope or the bullet. In like manner if it is once demonstrated that vaccination is a sure preventive against smallpox, and that it does not bring in its train any other evils, the person who refuses to avail himself of it, and thus makes his household a focus of danger for the community, not only may but should be "forced," all pleas of conscience notwithstanding. The whole question, then, is simply physical, and should be treated as such.

Unfortunately it cannot be denied that the opinion of the Faculty as to the certainty and the duration of the immunity obtained by this "Parliamentary rite," as Mr. Tebb calls it, has changed. Time was when vaccination once, in infancy, was deemed a sufficient protection for life. Then it was found desirable to repeat the operation at the age of puberty. Now it is recommended in addition whenever an epidemic of smallpox breaks out, and Dr. Collingridge, of the Port of London, is here quoted as recommending "thoroughly efficient *annual* vaccination." These proposals are an evident admission that the protection is neither absolute nor enduring.

The statistics given in the work before us are sufficiently alarming, and cannot be thoroughly discussed without a reference to documents which we have not at command. Certain considerations on the other side, however, suggest themselves. We are here told that the mortality from syphilis during the years 1850 to 1880 has increased from 37 per million to 84, or 124 per cent. This fact is given in evidence of the hazardous nature of vaccination. Now, that this operation has transmitted constitutional syphilis from the diseased to the sound we admit. But is it the only cause for the increase? And how is it that so many anti-vaccinators are at the same time unwilling that any measures for the eradication or the restriction of syphilis should be adopted? Why do they nickname endeavours in this direction "State regulation of vice?"

Again, let us take the cases where various other diseases have broken out, in children or in adults, after vaccination, and on the *post hoc ergo propter hoc* system are ascribed to this operation. Few persons like to confess themselves scrophulous, syphilitic, &c., and vaccination often—though by no means in all cases—serves as a convenient explanation for the occurrence of these diseases in their children. The fact must be admitted that

diseases of debility are undermining our stamina as a race, and unless we are found willing to modify our mad industrialism, and especially our love for competition in education, we shall ultimately succeed in "improving ourselves off the face of the earth."

To return: every right-thinking man must, we believe, feel indignant on learning that children born in work-houses, "when six days old," and even when twenty-four hours old, are often vaccinated. Nor can the compulsory re-vaccination of recruits on entering the army, or of candidates for employment in the Post Office, the police force, &c., be justified. With singular caprice, in the Inland Revenue Department, "the advantages of compulsory re-vaccination are reserved for the inferior and junior servants of a particular department," to wit, the stamping-room boys. Mr. Tebb remarks: "Surely the older servants and chiefs of the Department have more need of a renewal of the prophylactic than the stamping-room boys, whose vaccination, it may be presumed, is of comparatively recent date."

One feature in this work against which we must record our protest is the intimation, repeatedly met with in its pages, that medical practitioners, in upholding vaccination, are to no small degree influenced by the fees which they receive (see pp. 16, 56, 63). Yet a medical officer of health, quoted by Dr. Fox in a work reviewed in our present number, said: "The public cannot expect that I, who receive from them for my public services next to nothing, should do my best to prevent the extension of so *remunerative a disease* as smallpox, every case of which I consider, taking the average of fees obtained from rich and poor, to be worth to me a £5 note." Surely this is the view that a mercenary medical man would naturally take.

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*Proceedings of the Literary and Philosophical Society of Liverpool during the Seventy-second Session*, 1882-83. No. XXXVII. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

In these "Proceedings" we find abstracts of a few interesting papers which have not been thought worthy of publication in full. Especial mention must be made of a notice by Mr. E. Dukinfield Jones, C.E., on the remarkable drinking habit of a yellow and black Brazilian moth (*Panthra pardalaria*). The author found these moths sitting on the wet stones in small streams near San Paulo, sucking up the water in a continuous stream, and letting it escape in drops from the abdomen. These

drops fell at the average rate of 50 per minute, and as near as the author could judge of their size, the total quantity of water which must thus pass through the body of the moth in three hours must be a cubic inch, or about two hundred times the bulk of its own body. Mr. Jones speculates on the possible meaning of this dipsomania, and asks—"Can it be that the moth extracts nourishment from minute particles of organic matter contained in the water?" He remarks, however, that the water of the streams appears very clear and pure, and notes that the moths seem specially adapted for this habit. The tibiæ of the hind legs are very thick, and are armed with long hairs, which by their capillary action prevent the moth being immersed in the water. "I have often," he adds, "seen one of them knocked down by a little spurt of water splashing over the stone on which it was standing, and it recovered itself almost immediately without being wetted in the least."

Mr. Jones also contributes a paper on the question "Do Birds Eat Butterflies?" which is one of great interest as bearing upon the question of mimicry. He writes—"During the whole of my residence in Brazil, amounting in all to eight years and a-half, I cannot call to mind a single case of a bird that habitually devours butterflies, though I may have, now and then, seen a scissor-bird snap at a passing one, as we sometimes see our English sparrows do. But my opinion is that birds do not devour butterflies to an extent at all sufficient to account for a protective colouration of their wings through the action of natural selection."

Since writing our notice of Mr. Pascoe's "Notes on Natural Selection" we have questioned several old gardeners on the subject, but we have found none of them prepared to assert positively that any species of British bird does habitually prey upon butterflies. They had all, from time to time, seen a sparrow chasing a butterfly, and occasionally striking it down; but they could not distinctly state that the victim was eaten! The Old School were wont to tell us that the final cause of the wavering flight of butterflies was for their protection against birds.

Among the papers inserted *in extenso* we notice one by Mr. E. Davies, F.C.S., the President, "On the Unity of Life." The author insists ably on the absence of any tenable boundary between plants and animals, and is even, like ourselves, willing to admit that living vegetable protoplasm may possess "a dim consciousness of external influences with a corresponding measure of pleasure or pain." At the same time he finds between living and non-living matter a difference not of degree but of kind.

*Our Corner.* Vols. I. and II., 1883, and Parts 1, 2, 3, 4, 5, 1884. London: Freethought Publishing Company.

A VERY large portion of this heterodox contemporary consists of matter lying quite outside the sphere of the "Journal of Science." There are, however, valuable articles connected with science. Thus in the first volume we find Prof. L. Buchner discussing the "Force of Heredity," and its influence on the moral and mental progress of mankind. Here, whilst it is admitted that Darwin was the first fully and clearly to point out the importance of heredity, the merits of Girou de Buzaraingues, of Prosper Lukas ("Traité Physiologique et Philosophique de l'Hérédité Naturelle"), and of George Leroy, are brought into deserved prominence. The capital dictum of Burdach is also quoted, that "Descent has more influence on our bodily and mental character than all our external, material, and psychical surroundings." Many suggestive instances of the working of the principle are given. Not the least important is the case of a cock born with the abnormal number of five toes instead of four. This bird left behind him a numerous progeny of five-toed fowls. This incident refutes the argument put forward by the "Edinburgh Review" against Darwin to the effect that any modification cropping up in some individual plant or animal would be effaced by mating with normal individuals. Prof. Buchner's memoir is not, as far as we can find, concluded, and it is therefore scarcely fair to call attention to omissions. Still it is impossible to overlook the absence of all reference to the gainsayers of the doctrine of heredity. These persons are to be found not, as is commonly supposed, among ecclesiastics, but among politicians—angry at being told that they cannot mould men at will by franchises, constitutions, and schemes of compulsory education. Of these "talkers of talk" the most vehement and absurd was John Stuart Mill, who, reared upon words, could digest things, and who even sought to defend the old-world predominance of "the classics" in education as against science.

"Peeps through the Microscope" is an interesting series of articles by Mrs. Annie Besant, the editor, and will we think win new votaries for research into the tiny features of plant and animal life.

"Angling Memories of the Lea" is a brief but pleasant paper by one whom we should certainly not have suspected of being an observer of Nature, to wit, Mr. C. Bradlaugh, M.P. "Leaves and Trees" is a study by the same writer, and though it does not fall within the exact limits of any science we have read it with much pleasure.

"Alter Brown" gives an apparent case of clairvoyance by which he was at first deceived, but which was afterwards explained in a very matter of fact way. The clairvoyante, one

Elizabeth Marsden, saw, in trance, cinnamon in the stomach of a certain patient who had been advised by his physician to eschew all spices. It turned out afterwards that this young lady had learned the doctor's orders, and had seen the cinnamon being grated into a rice pudding for the patient's dinner.

"Science Corner" is a collection of novel facts compiled by Mrs. Besant.

Mr. C. T. Bingham writes on "Bird Architecture" and "Strange Nests." He points out an error in detail in one of the zoological galleries at the British Museum. The jays are not merely badly stuffed, but their nests are "fixed in the forks of naked branches glaringly unconcealed." This the writer justly pronounces contrary alike to observation and to the well-known character of the bird. But Mr. Bingham points out, in addition, an error in principle:—"As for any knowledge to be obtained of the course evolution has taken in the development of their forms, a visit to the British Museum, and, as far as I know, to any museum, is quite in vain."

Mr. J. Horner discusses caves and their formation, and the cave men by whom they were once inhabited. As might naturally be anticipated, he does not accept the eager pleadings of Principal Dawson for a term of six or seven thousand years as the extreme limit of the existence of man.

In the February, March, and April parts of Vol. III., Dr. E. B. Aveling—who seems equally at home in biology and in dramatic criticism—discusses, with unquestionable ability, the relations betweeen flowers and insects, a subject on which the last word has by no means yet been said.

Almost the only point which we disapprove of in "Our Corner," limiting ourselves of course to questions upon which we are free and competent to express an opinion, is the question of higher education. We find here no word condemnatory of cram and examinationism, and of bureaucracy in science.

## CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

### HANDKERCHIEFS PIERCED BY GROWING GRASS.

EARLY in April this year my attention was called to a row of five or six fine lawn handkerchiefs spread upon the closely-mown turf for the purpose of being bleached. They had been on the grass for five days, during which occured a remarkable change from cold and dry weather to a very showery time with almost unnatural heat. All the handkerchiefs were pierced by the points of the upspringing blades of grass; one of them had more than twenty points appearing, some of which had grown 2 inches above the handkerchief. I could see that many blades were bent back, and could not pierce the texture,—probably those which had truncated tips. On lifting the handkerchiefs no holes were discernible, even with the aid of a lens. The experiment has been repeated, under less favourable conditions, with partial success. In referring to the above observation, at a meeting of the Literary and Philosophical Society of Liverpool, my friend Dr. Carter illustrated the fact that in the piercing of stiff clay by the young shoot from a leguminous seed, the part in advance is not the leading cells, but the apse of the loop made by the stem. The question of chief interest to be investigated in the handkerchief experiment is the mode of connection between the parts of the blade below and above the fine lawn tissue which exhibited no marks of having been pierced.

HENRY H. HIGGINS.

### THE ENGLISH SYSTEM OF HIGHER EDUCATION.

ALLOW me to suggest a practical method by which your views, and those of certain of your correspondents on scientific and technical education, can be tested. Let returns be obtained (it can only be done with the consent of Government) of (*a*) the number of aliens employed in the United Kingdom as chemists,

engineers, designers, &c.; (*b*) the number of British subjects employed in similar positions abroad: (*a*) the number of aliens holding curatorships, professorships, &c., in British universities, colleges, museums, &c.; (*b*) the number of British subjects filling similar posts abroad: (*a*) the number of British subjects studying at foreign universities, &c.; (*b*) the number of aliens studying at British universities, &c.

If, when these returns are obtained, the values *a* are found to be comparatively large and increasing, whilst *b* are small and decreasing, then Professor Galloway is right, and the Committee of Council on Education, with its appendage the Department of Science and Art, is wrong. If *a* is relatively small and decreasing, then Prof. Galloway is mistaken.

As one crumb of fact I may mention that in the year 1858 there was in the Lancashire alkali district *one* foreign chemist employed. Now it would be easy to count up a dozen!

LOOKER-ON.

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## A PLEA FOR CRAM.

THOUGH you are the persistent and indefatigable opponent of the English system of education, your well-known candour will, I think, induce you to give space to the following considerations:—It often happens, in various walks of professional life, that a man has to get up a subject for some particular occasion, and that at a very short notice. He is not required to produce any original research on the subject, but merely to have at his command a fair summary of the present state of human knowledge in that department. When the occasion is over he may never want this information again, and if he forgets it he is therefore no loser.

Now if a considerable part of a man's education has consisted in qualifying himself for examinations, and in passing them, he will, I think, find the task easier and more congenial than if his early training had, as you recommend and as the Germans seem to practise, consisted in qualifying himself for profound original research.

E. L. N.

## NOTES.

THE notices in the various newspapers of the "Giant Electric Microscope" at the Crystal Palace are amusing. All of them seem charmed with the enormous magnifying power of the instrument: that the eye of a small sewing needle can be enlarged to the apparent dimensions of 6 feet by 4 is evidently to these critics a performance surpassing that of any microscope yet constructed, and doubtless wonderful enough to those unfamiliar with the performance of the instruments commonly used by microscopists. Magnifying power alone has long ceased to be the great desideratum with workers; if everything else is sacrificed there is very little limit in this direction, provided light can be found to render the enlarged image brilliant enough to be seen. Definition is quite another thing: this taxes the skill of the optician to the utmost, and demands the most exact correction of the aberrations; great perfection has been reached, and the modern microscope has already accomplished that which theory formerly declared to be impossible. With regard to images thrown upon a screen very good definition is attainable; when a large surface is not required to be covered the fine quality of the numerous representations of microscopic objects by photography affords ample proof of what has been done,—all that the best microscopes can render visible has under certain conditions been faithfully reproduced. The delineations of the *supposed* minute markings on insect scales and diatom valves are marvellous, surpassing anything that the human hand can depict. Unfortunately, however, when the amplification is increased to an amount sufficient to render minute objects visible to a large audience, definition breaks down altogether, and only an enlarged image, of which the minute details are badly or not at all rendered, remains. The late Andrew Ross endeavoured to improve the definition of the projection microscope, but obtained no very good result. At present the only way of exhibiting a microscopic object on a screen in a satisfactory manner is to enlarge a photo-micrograph by means of a good magic-lantern; admirable results are obtained by this indirect method, while the direct projection of the magnified image of a minute object is at the present time a desideratum. The "Giant," so far as investigation is concerned, can be surpassed by a pigmy in the shape of a good pocket lens.

M. E. L. Trouvelot considers that the rings of Saturn cannot, on account of their changes of form, be regarded as solid bodies.

The hypothesis that these rings are composed of a multitude of small satellites describing independent orbits around the centre of gravity of the planet explains the phenomena observed much better.

A. Arès (" Ciel et Terre ") contends that the red colour of Mars is due not to its soil or its vegetation, but to its atmosphere.

According to the " Journal d'Hygiene " citric acid is a most powerful disinfectant, preserving meat from putrefaction, and proving rapidly fatal to septic microbia. The soluble citrates have no similar action.

M. Poincairé (" Comptes Rendus ") contends that the attraction of the moon modifies the intensity of gravitation. Hence at the Equator the clock is retarded by half a second yearly by the combined attraction of the sun and moon, and advanced a second at the Poles.

The inhabitants of Chiloe use as a weather-indicator the shell of a crab of the family *Anomura*, belonging probably to the genus *Lithodes*. It is almost white in fine weather, becomes covered with small red spots on the approach of moisture, and is almost entirely red when rain actually falls (" Ciel et Terre ").

Mr. Maxwell Hall (" Monthly Notices of the Royal Astronomical Society ") gives the following remarkable sequence of colour in the planets from the Earth outwards :—*Mars*, reddish; *Jupiter*, a delicate orange; *Saturn*, greenish yellow; *Uranus*, light green; and *Neptune*, slightly blue.

M. Faye (" Comptes Rendus "), after a careful examination, decides that the cosmogenic theory of Kant has not the smallest analogy with that of Laplace.

M. Milne-Edwards gives an account of a young male gorilla living at present in the Jardin des Plantes. This animal is savage and morose, taking no part in the sports of the other apes, and being apparently inferior in intelligence even to the gibbons.

M. J. Thoulet finds that the spiculæ of living sponges consist of pure silica.

Since the practical suspension of the " Infectious Diseases Act," effected by Mr. Stansfeld's motion last year, the number of syphilitic cases in the military hospital at Colchester have increased 300 per cent.

At a meeting of the Washington Biological Society (" Science ") Mr. H. W. Elliott proved that the musk-rat (*Faber zibethicus*) is zoophagous, and preys largely on carp.

M. C. Barthelemy ("Comptes Rendus"), having placed a number of hyacinths in glasses in a circle around the pipe of a stove, found that the roots took an almost horizontal direction towards the pipe, as a common centre of attraction.

M. Legrand du Saulle ("Medical Press and Circular") notes the increase of insanity in France, which he ascribes to the thirst for enjoyment, the passion for riches, the risks on the Exchange (in other words to worry), and above all to alcoholism.

[Fully admitting the increase of alcoholism in France, we may still ask whether it, too, is not to a great extent due to worry?)

The 500th anniversary of the foundation of the University of Heidelberg will shortly be celebrated. The sum of £8000 has been voted by the Baden Parliament to defray the expenses.

P. Rosenbach has found experimentally that potassium bromide diminishes the sensibility of the cortical substance of the cerebrum to electric excitement, whilst the excitability of the underlying white substance remains unaltered.

P. Hende announces the existence in Corea of a small ruminant of the genus *Hydropotes*, differing from the *H. inermis* of Swinhoe, both by its cranial characters and by the lighter colour of its coat.

Four species of fossil reptiles, of the genus *Simædosaurus*, have been recently discovered in the neighbourhood of Rheims.

Mr. David Hooper, F.C.S., of Birmingham, has been appointed, by the Secretary of State for India, Analytical Chemist and Quinologist to the Nilgiri Government Cinchona Plantations in the Madras Presidency.

[A learned contemporary states that Mr. Hooper has been appointed "Analogist" to the Plantations.

Mr. J. P. Joule, the illustrious physicist, speaking of Dr. Bardsley's proposal to stamp out hydrophobia by keeping all dogs isolated for four months, says:—"It is difficult to understand the intellectual and moral condition of a public which, by the neglect of this obvious precaution, consigns to a frightful death probably as large a number of persons as those who by common custom are exclusively spoken of as murdered."

It appears that there are now, in London, three distinct Spiritualist associations, two Theosophic societies,—one of which, the "Hermetic Lodge," includes not a few prominent Bestiarians,—besides the Society for Psychical Research, in which, according to "Light," the "veriest agnostic may find rest for the sole of his foot, and wonder how he came there."

According to a letter which the "Medical Press" quotes from the "Madras Courier" of 1819, inoculation for smallpox, and

probably also vaccination, were practised in India in very ancient times.

Prof. Virchow, in a speech delivered at the recent Edinburgh Tercentenary, remarked that his opinions on Evolution have been much misunderstood. "I never was hostile to Darwin,—never have said that Darwinism was a scientific impossibility."

A species of rice has been discovered in Mantchuria which can be cultivated without irrigation, and consequently without risk to the health of the district. Whether it is equally productive with the common species remains an open question.

Mr. W. M. Flinders Petrie finds proofs that the ancient Egyptians cut their hard building-materials, such as diorite, granite, basalt, &c., by means of instruments pointed or edged with diamonds or sapphires.

Mr. Mallard Reade, writing in the "Geological Magazine," calls attention to the fact that South Georgia, though 1200 miles from the nearest continent, and therefore entitled to be called an "oceanic" island, is composed of clay-slate. This fact, he considers, "strikes a vital [? deadly] blow" at the hypothesis of the permanency of oceans and continents. The mountains are from 2000 to 3000 metres high, and no land-mammals were found on the island.

"Ciel et Terre," on the authority of Caillie, raises the question whether swallows, of the same species as those which visit Europe, do not remain in Africa during the breeding-season.

Some years ago we called attention to the sanitary legislation of the Pentateuch, as being in many points in advance of our modern practice. We now learn that, according to the law of Buddha, should a man or woman unwittingly marry into a family afflicted with hereditary disease, such as leprosy, cancer, syphilis, madness, &c., he or she may sue out a divorce. According to the "Medical Press" Buddhists are taught to believe that not only will the children of diseased parents inherit a transmissible disease, but that the husband or wife will contract the same by association.

The "American Naturalist" lays down ten commandments for scientific men. We quote one of them:—"Thou shalt not fall into the snare of the devil, and believe thou wilt wax great by the making of long names to torment thy people."

We hear rumours that Prof. Flower finds himself interfered with in his management of the Natural History portion of the British Museum, by intrigues emanating from a well-known quarter.

It is a curious fact that whilst *Helota Africana* is found in

Angola, all the other species of the genus occur exclusively in Eastern Asia.

We regret to put on record the death of Sir Sidney Saunders, a Vice-President of the Entomological Society. The deceased was an accurate and thorough-going investigator, and is well known for his researches on the metamorphoses of the Cantharidæ, and on the internal parasites of the fig.

Dr. Donovan ("Medical Press and Circular") drily remarks that the Right Hon. A. Mundella may be thoroughly competent to frame laws having regard to the Nottingham stocking-trade, but that the manufacture of stockings does not render that estimable gentleman an infallible authority on medical reform. (Surely Dr. Donovan must know that a Privy Councillor is simply, as such, an infallible authority on all questions, scientific, literary, artistic as well as practical, and that if so inclined he may be elected F.R.S. almost as a matter of course.)

The Rev. Canon Curteis ("Nineteenth Century"), criticising Mr. Herbert Spencer, asks "Why should human dreams produce a religion, and bestial dreams produce none?" Is he sure that the latter produce none?

We are sorry to notice the death of Dr. R. Angus Smith, formerly assistant to Dalton, and latterly Chief Inspector under the Alkali Act. It will not be easy to find anyone who can administer this Act so satisfactorily, and at the same time with so little injury to the interests involved.

Almost at the same time died Prof. C. Wurtz, Professor of Chemistry at the Paris Faculty of Medicine, and at the Sorbonne. His death will leave Prof. Berthelot almost as supreme in the chemical department of the Academy of Sciences as is Prof. Milne-Edwards in the biological sphere.

According to Eugene Bonnemère ("Light") Zoroaster rejected asceticism and condemned the so-called virtues of monks.

The "Sporting and Dramatic News" (Saul among the Prophets?) has begun to publish cases of the fulfilment, or almost fulfilment, of several dreams.

Dr. C. C. Abbott ("Science") concludes that hybernation is a happy faculty which certain animals possess, but do not willingly exercise, as long as the temperature is sufficiently high and food is accessible.

M. Pasteur states that he "never could kill a bird for sport, though in the cause of Science he has no scruples." What a fine contrast to our anti-vivisectionist sportsmen!

It is announced that in October Sir W. Thomson will deliver a course of eighteen lectures on molecular dynamics, at the Johns Hopkins University.

Mr. Scott, in a paper recently read before the Meteorological Society, contended that the centigrade thermometer was invented not by Celsius, but by Linnæus, whilst Réaumur's scale is really due to De Luc.

A M. Ansart, writing in "Cosmos les Mondes," contends that "the Glacial epoch is the natural consequence of a miraculous, supernatural phenomenon, the *universal deluge*.

A bed of native coke is said to have been discovered at Las Cerillos, in Mexico, interposed between two strata of bituminous coal and of anthracite.

"M.A. (Oxon)," writing in "Light," denounces the "World" for the "fierce and bitter malignity" evinced in its recent article "Snobbery and Superstition."

M. Houzeau ("Ciel et Terre"), discussing the alleged satellite of Venus, argues that the body in question is a planet revolving at a small distance exterior to Venus, and that it is probably a satellite which has escaped from the control of its primary. He gives it the name of Neith.

The highest temperature registered in New South Wales in January last was 122° F. (50° C.)

According to the "Æsculapian" there prevails in the neighbourhood of Yakutsk an affection known as "miryachit." The patients behave very similarly to the "Jumpers" of Maine (*see* "Journal of Science," 1879, p. 247). The "Medical Press" considers that should the description of this nervous affection prove correct, it will go far to sweep away Heidenhain's explanation of hypnosis as a result of inhibition of the action of the higher nervous centres.

The Royal Commission on the discharge of sewage into the Thames state that "Nobody has hitherto anticipated that liquid discharged into the river at Barking could be transported many miles up the river in the face of the powerful descending stream of land-water; but that this effect is produced can no longer be doubted."

We learn from a medical contemporary that there exists a combined "Vigilance Association"—"an organisation of anti-vaccinationists, anti-vivisectionists, and anti-contagious-disease agitators," for the purpose of "blocking" any Bills brought into Parliament which may be hostile to the ends of these worthies. Have the medical and the scientific world not influence enough to organise a counter "Vigilance Association"?

According to the "Medical Press" Dr. Koch, in recognition of his researches into the origin of cholera, has received from the Reichstag the sum of £5000, and is nominated to the Crown Order of the second class. What a contrast to England!

Says our distinguished contemporary, "Science":—"Twelve years ago the thorough-going policy of the British Admiralty in fitting out the *Challenger* Expedition inspired us all with a hope that a new kind of governmental policy, in support of biological investigation was being inaugurated. American as well as English naturalists have therefore been greatly disappointed that, since the return of the *Challenger*, the British Government has done practically nothing to forward marine research. The economists of the Manchester school are still in the ascendant, and the study of animal life is evidently to be left, like fish-culture and the prediction of the weather, to private enterprise. (The rewards for biological research in England are the shrieks and vituperations of fanatics, and the possibility of fine and imprisonment.)

A movement has sprung up in Canada which deserves support. The Government has been requested to consider a naturalists' exchange post for Canada and the other countries within the postal union.

An *Isaria*, a fungus parasitic on *Bombyx rubi* (according to the "Kansas Review of Science"), in passing from one stage of its growth to another, not only changes from one species and genus to another, but actually overleaps the chasm that separates one family from another,—starting as a member of *Hyphomycetes*, and ending as a member of the *Ascomycetes*.

The remains of Prof. Gross, styled the "Nestor of American Surgery," have, according to his will, been cremated at the furnace erected at Philadelphia.

C. Sternberg ("Kansas Review of Science") declares the fossil Dakota flora a wonderful disproof of the theory of Natural Selection. He alleges that "the grand flora of the Dakota appeared with no intermediate species between it and the coal-plants of the carboniferous," and further that the cretaceous flora is "as perfect as any of the present day."

According to Prof. Riley *Pyrethrum* powder is poisonous to the higher animals as well as to the lower forms of life.

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ERRATUM.—In our May issue, p. 296, line 19 from bottom, *for* Bates *read* Belt.